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March 20, 2018

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RE: Proposed 2018 Collection of Smallmouth Bass in the Willamette River for Portland Harbor Pre-Remedial Design Investigation (PDI) and Baseline Sampling Studies

Dear Ms. McGrath and Mr. Rule:

This letter has been prepared to notify you of two upcoming smallmouth bass (SMB) collection efforts in the Willamette River. The first collection effort is proposed for late April/early May 2018 to support implementation of a year-long fish tracking study. The second collection effort is proposed for August and September 2018 to conduct a fish tissue analysis study. Only SMB will be targeted during these studies; no federally listed salmonids will be collected. These studies comprise two of the eight US Environmental Protection Agency (EPA)-approved Portland Harbor Pre-Remedial Design Investigation (PDI) and Baseline Sampling Studies, which are a foundational step in what will be a multi-phase effort to update current conditions from the collection of data during the previous remedial investigation/feasibility study (RI/FS).

The Portland Harbor Superfund Site Record of Decision (ROD) described a post-ROD sampling effort for the Superfund Site (Site or PHSS) located in Portland, Oregon, to delineate and better refine the sediment management area (SMA) footprints, refine the conceptual site model (CSM), determine baseline conditions, and support remedial design (EPA 2017a). In December 2017, Geosyntec Consultants, Inc. (Geosyntec), and AECOM Technical Services (AECOM) submitted a Work Plan for PDI Studies on behalf of a group of industrial parties called the Pre-Remedial Design Agreement and Order on Consent Investigation Group (Pre-RD AOC Group). On December 19, 2017, EPA entered into an Administrative Settlement Agreement and Order on Consent (ASAOC) with the Pre-RD AOC Group to conduct the PDI studies at the Site (EPA 2017b). The ASAOC includes the Statement of Work (SOW) and the PDI Work Plan, which generally describe the field investigation activities, data analyses, schedule, and deliverables for the PDI. Since then, we have prepared draft field sampling plans for EPA review for all eight study activities, including the fish tracking study and fish tissue study. We expect that these field plans will be finalized soon.

The PDI Study Area (the Study Area) includes two sections of the Willamette River:

1. The Portland Harbor Superfund Site from River Mile [RM] 1.9 to RM 11.8.
2. The two upstream reaches from RM 11.8 to RM 28.4 which are collectively referred to as the Downtown/Upriver (D/U) Reach:
 - a. The Downtown Reach from RM 11.8 to RM 16.6
 - b. The Upriver Reach from RM 16.6 to RM 28.4

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), known also as "Superfund" Section 121(e)(1) and the National Contingency Plan 40 CFR, Section 300.400(e)(1) exempt the requirement for federal, state, or local permits for onsite response actions conducted pursuant to CERCLA. However, this exemption does not extend to the substantive requirements (EPA 1992, 1988). Although no permits are technically

required due to this CERCLA activity, in order to meet the substantive requirements, we will prepare an Oregon Scientific Taking Permit Application for each study in order to obtain Oregon Department of Fish and Wildlife (ODFW) Scientific Take Permits. The permit reporting process will allow ODFW to track the type and number of species captured during each study. These Oregon State permit applications will be submitted through the National Marine Fisheries Service (NMFS) Authorizations and Permits for Protected Species (APPS) website. We will follow the ODFW conditions and reporting requirements associated with these permits. The ASAOC states that all PDI activities must be completed by spring 2019; as such, we are working under an extremely accelerated time schedule to complete this project within the EPA-approved timeframe. If the project was not exempt from federal Endangered Species Act (ESA) permits, we would be unable to obtain either a Section 4(d) scientific research authorization or Section 10(a)(1)(A) scientific research permit due to the time-sensitive nature of these activities.

Below we have provided the Applicable or Relevant and Appropriate Requirements (ARARs) for the proposed fish collection activities that are designed to meet ESA Section 4(d) requirements. These ARARs were implemented during previous 2011 and 2012 SMB collection activities in the Willamette River performed for the EPA and Lower Willamette Group. To minimize the unintentional catch of federally listed salmon and steelhead during the collection of SMB, the following conditions will be adhered to:

- (1) Only rod and reel angling will be conducted (no seining or electroshocking).
- (2) The field crew will include biologists who are trained and experienced with identifying ESA-listed species in the Willamette River.
- (3) If any ESA-listed species are caught during angling, all fishing efforts will stop in that sampling area and the field crew will move to a different sampling area. The listed fish will be returned to the water as quickly as possible and NMFS, ODFW, and EPA will be notified by email at the end of the sampling day.

Below we have summarized the proposed fish collection efforts associated with both studies. For more information, please refer to the draft field sampling plans that are attached to this memorandum. These plans will also be included with the ODFW scientific taking applications that will be submitted on the APPS website. The proposed angling methods, in conjunction with the minimization and conservation measures that will be implemented, will help avoid the potential risk of take of any ESA-listed salmonids in the Willamette River.

- (1) Fish Tracking Study. The goal of this study is to improve the understanding of fish residency and exposure areas that affect the sediment-fish tissue relationship in the Superfund Site. The study focuses on SMB (versus other resident species) because of their abundance, more limited home range, extensive historical chemistry database, and importance in the Baseline Human Health Risk Assessment (BHHRA). The sampling design and approach are based on the current understanding of the river system and the target fish species; the specifications and capabilities of the acoustic telemetry equipment, which have been informed by a June 2017 pilot study; and the project-specific objectives.

A total of 34 HTI-Vemco VR2 acoustic receivers will be installed in the river as part of this study. The layout of the acoustic receiver array will be a combination of "gates" (designed to track fish presence/absence) and more closely spaced receiver positions designed to track fine-scale fish movement in specific areas of interest. A series of gates consisting of transects of two to three receivers will be installed at each river mile between RM 5 and RM 9 (Attachment A). These gates will track fish movement on a river mile scale in a section of the river that is representative of conditions and SMB habitat across the Site. Gates will also be installed at the Site boundaries (RM 1.9, RM 11.8, and the mouth of Multnomah Channel) and at three areas of interest: Willamette Cove (RM 6.8), Swan Island Lagoon (RM 8), and near the Cargill/Glacier terminals (RM 11.5E). The combination of RM and fine-scale acoustic tracking of SMB over the year-long study duration is expected to provide a robust and representative dataset for characterizing the seasonal movement and home range of SMB throughout the Site.

The study will involve the collection of approximately 40 SMB using hook-and-line methods, surgical implant of an acoustic tag, and subsequent release back to the river following a recovery period. The study is scheduled to begin on April 23, 2018 with the deployment of receivers; fish collection and tagging would

begin on April 30, 2018. These combined efforts would take place over a period of approximately two to three weeks. Fish collection will be prioritized in the vicinity of the three target areas (Willamette Cove, Swan Island Lagoon, and RM 11.5E), supplemented with fish collection in the RM 5 to RM 9 area as needed. Angling efforts will be focused on locations that were productive in prior sampling events. SMB greater than 228 millimeters (9 inches) will be targeted for the study. Fish collection activities will be performed on vessels provided by a subcontractor (Gravity Marine Services, supported by the Oregon Bass and Panfish Club). These boats will be equipped with aerated livewells in order to store/transport SMB between the collection site and the landside surgery station. All smaller-sized SMB or other fish incidentally captured will be immediately and safely returned back to the river.

Angling will be conducted using practices successfully used during the 2011 and 2012 SMB collection efforts. Competent and trained anglers will use a standard rod and reel with monofilament line (6-12 lb test). SMB can be caught with a variety of lures, depending on the desired sampling depth. Lead-weighted hooks with attached green-rubber tube jigs will be used to fish the bottom, while plastic crank baits resembling small fish or crayfish will be used to fish the shallower surface waters (zero to 4 meters). Electric trolling motors may be used to more accurately access specific SMB angling locations and enable the complete coverage of selected areas. Angling will be conducted primarily from 7:00 a.m. to 7:00 p.m.

Although the lower Willamette River supports five federally threatened salmonids, the probability of take using the proposed angling techniques are very low. Hook and line fishing for SMB has been performed in the Willamette River in support of the Portland Harbor Superfund Site RI/FS in 2007, 2011, and 2012. We are not aware of any salmonids that were incidentally captured during any of these studies. Most recently in 2012, a total of 92 SMB were collected for tissue analysis over 20 days of fishing throughout the lower Willamette River (LWG 2012). Boat operation and angling assistance during the fish sampling were provided by the Oregon Bass & Panfish Club and The Bass Federation of Oregon. The Oregon Bass & Panfish Club will be assisting with the 2018 effort as well and are knowledgeable about collection techniques to minimize the inadvertent capture of salmonids. Once the 40 target-size SMB are captured and tagged, it is not anticipated that any further fish collection would be required for this study. Receivers will be checked monthly for operational status using a topside transponder and data downloads are scheduled to occur every three months. Telemetry equipment will be retrieved at the conclusion of the study in spring 2019.

- (2) Fish Tissue Analysis Study. The focus of this sampling effort is the collection of whole body SMB throughout the Site and upstream of the Site to characterize current concentrations of ROD contaminants of concern (COCs). This study is targeting SMB because of their abundance, more limited home range, extensive historical chemistry database, and importance in the BHHRA. Fish tissue is one line of evidence for monitored natural recovery. The specific goals of the fish tissue sampling include the following: (1) characterize current levels of fish tissue COCs in resident SMB tissue on a site-wide basis and smaller spatial scale, (2) characterize upriver concentrations in fish tissue, (3) update statistically based evaluations of polychlorinated biphenyl (PCB) differences and changes in fish tissue concentrations, and (4) update and evaluate study area conditions to refine the CSM for all pathways consistent with the ROD.

The study sampling design is consistent with the most recent and approved 2012 SMB program, which included sampling and analysis of whole body specimens throughout the Site and a portion of the D/U Reach. The design includes collection of one specimen from each of 95 sampling locations within the Site, as well as 20 specimens from the Downtown Reach and 20 from the Upriver Reach (Attachment B). The target number of specimens within the Site is the same as the 2012 program. While a total of 135 SMB are targeted, the number collected will be to the extent sufficient numbers of fish are present in the summer/fall of 2018. Fish collection is expected to include two 10- to 12-day sessions: one session in August and one in September. At the end of the first sampling session, the SMB catch rate will be evaluated in consultation with EPA to determine if adjustments to the FSP are needed to achieve the target sample number. Consistent with the 2011 and 2012 sampling, SMB that are 225 to 355 mm in total length (approximately 9 to 14 inches) will be targeted. Specimens that do not meet the target size range will be released. SMB larger than 355 mm may be retained for archival at the selected laboratory for possible future analysis.

Sampling will be conducted using a two-boat team. Angling will be conducted using the same collection methods described above for the fish tracking study. Once caught, target-sized SMB will be handled using nitrile gloves, unhooked, weighed and measured, euthanized, and immediately wrapped in aluminum foil and placed into individual resealable plastic bags. The field crew will include experienced AECOM fisheries biologists who are trained and qualified to implement fish tissue collection, maintain field documentation, and ensure ARARs, as well as minimization and conservation measures are being properly implemented.

We appreciate the opportunity to notify you of these upcoming fish collection efforts. Angling efforts will not commence until an ODFW scientific taking permit is obtained for each study. Please let us know if you have any questions or comments about either of the proposed studies. Thank you in advance for your consideration and cooperation.

References:

EPA. 1988. CERCLA Compliance with other Laws Manual, Interim Final. EPA/540/G-89/006. U.S. Environmental Protection Agency. Office of Emergency and Remedial Response.

EPA. 1992. Permits and Permit "Equivalency" Processes for CERCLA On-site Response Actions. OSWER Directive 9355.7-03. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response.

EPA. 2017a. Record of Decision Portland Harbor Superfund Site, Portland, Oregon. United States Environmental Protection Agency Region 10, Seattle, WA. January.

EPA. 2017b. Administrative Settlement Agreement and Order on Consent and Statement of Work for Pre-Remedial Design Investigation and Baseline Sampling. Agreement between EPA Region 10, Seattle Washington and the Pre-Remedial Design Group. CERCLA Docket No.10-2018-0236. December 19.

LWG. 2012. 2012 Smallmouth Bass Sampling for the Portland Harbor RI/FS. Letter from Bob Wyatt to Chip Humphrey (EPA). October 25, 2012

Yours sincerely,



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Attachment A. Draft Fish Tracking Study Plan

Attachment B. Draft Fish Tissue Analysis Study Plan

Attachment A

Draft Fish Tracking Study Plan

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January 18, 2018

Mr. Davis Zhen, Project Coordinator
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Subject: **Portland Harbor Superfund Site
Pre-Remedial Design (Pre-RD) Investigation and Baseline Sampling
Fish Tracking Sampling Plan
CERCLA Docket No. 10-2018-0236**

Dear Mr. Zhen:

On behalf of the Pre-RD AOC Group, AECOM is pleased to submit the Fish Tracking Field Sampling Plan (FSP) in accordance with the Administrative Settlement Agreement and Order on Consent (ASAO) for Pre-RD Investigation and Baseline Sampling.

The attached document describes the activities to be performed in compliance with the Statement of Work Section 3.1 "Scope of Pre-Remedial Design Investigation (PDI)" and Section 5.7(c) "Supporting Deliverables to PDI Work Plan" approved by the U.S. Environmental Protection Agency (EPA) as part of the ASAO.

We understand the EPA has 30 days to review the attached document. In the interest of expediting the project, we encourage a meeting to assist with a timely review and approval process.

Again, on behalf of the Pre-RD AOC Group, we are pleased to submit the referenced document and look forward to assisting in the review process.

Sincerely,

Kenneth M. Tyrrell
AECOM Project Coordinator
Executive Vice President
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Copies: Pre-RD AOC Group, Mr. Hans Feige

AGENCY REVIEW DRAFT

Acoustic Fish Tracking Study Field Sampling Plan

Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling Portland Harbor Superfund Site

AECOM Project Number: 60554349
Geosyntec Project Number: PNG0767A

January 18, 2018

Prepared for:

United States Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 900
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On behalf of:

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CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.



January 18, 2018

Kenneth M. Tyrrell
PDI Project Coordinator
AECOM Technical Services

Date

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ACRONYMS AND ABBREVIATIONS

AECOM	AECOM Technical Services
ASAOC	Administrative Settlement Agreement and Order on Consent
Ballard	Ballard Marine Services
BHHRA	baseline human health risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
CSM	Conceptual Site Model
DGPS	differential global positioning system
DO	dissolved oxygen
DQMP	Data Quality Management Plan
DQO	data quality objective
DSL	[Oregon] Department of State Lands
DUO	data use objective
EPA	United States Environmental Protection Agency
FC	Field Coordinator
FS	feasibility study
FSP	Field Sampling Plan
g	gram
Geosyntec	Geosyntec Consultants, Inc.
Gravity	Gravity Marine Services,
ID	identification number
kHz	kilohertz
km	kilometer
LWG	Lower Willamette Group
m	meter
ODFW	Oregon Department of Fish and Wildlife
PDI	pre-remedial design investigation
PHSS	Portland Harbor Superfund Site
Pre-RD AOC Group Investigation Group	Pre-Remedial Design Agreement and Order on Consent

QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RI	remedial investigation
RM	river mile
ROD	Record of Decision
Site	Portland Harbor Superfund Site
SMB	smallmouth bass
SOW	Statement of Work

1. INTRODUCTION

The Record of Decision (ROD) described a post-ROD sampling effort for the Portland Harbor Superfund Site (Site or PHSS; Figure 1) located in Portland, Oregon, to delineate and better refine the sediment management area footprints, refine the Conceptual Site Model (CSM), determine baseline conditions, and support remedial design (United States Environmental Protection Agency [EPA] 2017a). Geosyntec Consultants, Inc. (Geosyntec), and AECOM Technical Services (AECOM) submitted a Work Plan for Pre-Remedial Design Investigations (PDI) on behalf of a group of industrial parties called the Pre-Remedial Design Agreement and Order on Consent Investigation Group (Pre-RD AOC Group). On December 19, 2017, EPA entered into an Administrative Settlement Agreement and Order on Consent (ASAOC) with the Pre-RD AOC Group to conduct the PDI studies at the Site (EPA 2017b). The ASAOC includes the Statement of Work (SOW) and the PDI Work Plan (an attachment to the SOW), which generally describe the field investigation activities, data analyses, schedule, and deliverables for the PDI.

These PDI studies are a focused and foundational step in what will be a multi-phase effort to update current conditions from the collection of data during the remedial investigation (RI)/feasibility study (FS). The RI/FS was initiated by a group of potentially responsible parties known as the Lower Willamette Group (LWG) and completed by EPA in 2016 (EPA 2016a, 2016b). The RI consisted of three rounds of data collection, including surface and subsurface sediment, bank soils, surface water, sediment traps, porewater, fish tissue, and other media from 2001 through 2007.

This Field Sampling Plan (FSP) was prepared to support the acoustic fish tracking study outlined in the PDI Work Plan (Geosyntec 2017) and the project Quality Assurance Project Plan (QAPP) (AECOM and Geosyntec 2018a).

1.1 Project Setting

The PHSS is located in Portland, Oregon, on the lower Willamette River immediately downstream of the urban downtown. The Site extends from river mile (RM) 1.9 upstream to RM 11.8 and covers 2,190 acres (Figure 1). There are two reaches located immediately upstream of the Site. The Downtown Reach, which includes the urbanized area of downtown Portland, is defined by EPA as extending from RM 11.8 to RM 16.6. EPA defines the Upriver Reach as extending from RM 16.6 to RM 28.4.

1.2 Project Overview

The RI included preparation of a baseline human health risk assessment (BHHRA), baseline ecological risk assessment, and food web model (Kennedy/Jenks 2013a; Woodward Environmental 2013, 2015). The BHHRA identified several persistent lipophilic compounds, including polychlorinated biphenyls, as contaminants of concern (COC) based on their bioaccumulation into fish.

The PDI studies are designed to update the RI/FS dataset and characterize current conditions, refine the CSM for all pathways consistent with the ROD, and refine delineation of active remedial areas. In addition to updating sediment, surface water, and tissue chemistry data sets, the PDI scope of work includes a year-long acoustic fish tracking program to capture fine-scale temporal and spatial movement of Smallmouth Bass (*Micropterus dolomieu*; SMB) at the PHSS.

1.3 Study Objectives and Data Uses

The overall goal of the fish tracking study is to improve understanding of fish residency and exposure areas that affect the sediment-fish tissue relationship. The study focuses on SMB (versus other resident species) because of their abundance, more limited home range, extensive historical chemistry database, and importance in the BHHRA. The specific data quality objectives (DQOs) include the following:

- Monitor resident fish movement in the lower Willamette River over an approximately 1-year period to understand seasonal movement, habitat use/preference, and home range.
- Provide a monitoring network sufficient to characterize river mile and fine-scale movement of SMB and whether tagged fish leave the PHSS.
- Generate a dataset that supports reliable estimates of home range area and bank travel distance of SMB in the PHSS.

The results of the study will be used to inform the fish tissue sampling scheduled for late summer 2018 and support the analyses identified in the PDI Work Plan.

2. SAMPLING DESIGN AND APPROACH

The overall sampling design, rationale for approach, DQOs, and data use objectives (DUOs) are described in the PDI Work Plan. This FSP provides the additional details necessary to ensure that execution of the study will achieve the project-specific DQOs and DUOs set out in Section 1.2 of this FSP and Section 1.3 of the QAPP (AECOM and Geosyntec 2018). The sampling design and approach are based on the current understanding of the river system and the target fish species; the specifications and capabilities of the acoustic telemetry equipment, which have been informed by a June 2017 pilot study; and the project-specific DQOs and DUOs. This section of the FSP presents the basis of the study design, including the location and array of receivers and the targeted number of tagged fish. A sample size of 40 tagged fish has been selected for the PDI study. This number is sufficient to generate a robust dataset, even if some fish are lost over the course of the study. A summary of prior fish tracking studies in the PHSS is presented first for context, followed by details on the proposed 2018 fish tagging study.

2.1 Previous Studies

Two prior studies have been conducted in the PHSS that provide information useful for the design of the acoustic fish tracking study. A study conducted by Oregon Department of Fish and Wildlife (ODFW) in the lower Willamette River in early 2000s used radio tracking technology to track fish movement. In 2017, a pilot study evaluated the performance of acoustic telemetry systems in the river (AECOM 2017a). Radio tracking provides “opportunistic” measurements of fish location (e.g., weekly, bi-weekly) that are not highly refined. Acoustic tracking provides a more refined understanding of fish movement in time and space.

2.1.1 2000-2003 ODFW Radio Tracking Study

From 2000 to 2003, ODFW performed a radio tracking survey of four predator species in the lower Willamette River from RM 0 to ~RM 26 (Pribyl et al. 2005). A total of 73 fish were implanted with Lotek tags (battery life ranging from 238 to 439 days), including 8 walleye, 37 northern pikeminnow, 23 SMB, and 5 largemouth bass. Radio tracking was conducted by boat on an irregular basis, about 1 to 10 days per month from May 2000 to July 2003. A total of 53 of the 73 tagged fish were relocated during radio tracking at least once (i.e., location of tagged fish was recorded by the radio receiver), including 96% of the SMB. A total of 264 relocations were recorded over the survey period. Anglers captured four radio-tagged fish. Most tagged fish were relocated offshore (defined as greater than 10% of the measured channel width to either bank), often adjacent to a structure, such as pilings or floating structures. The distribution of radio-tagged fish across the river channel indicated a preference for areas within 20% of either shoreline. For SMB, the median total distance traveled (upstream and downstream movement) was 4.3 kilometers (km) (2.7 miles), and the 25th and 75th percentiles were 0.8 km (0.5 mile) and 8.0 km (5 miles).

2.1.2 2017 Acoustic Tracking Pilot Study

In June of 2017, an acoustic fish tracking pilot study was conducted to test the technical feasibility of acoustic tracking in the lower Willamette River environment and perform a side-by-side comparison of two different acoustic telemetry systems (HTI-Vemco and Lotek Wireless) (AECOM 2017a). The pilot study assessed and confirmed the technical feasibility of acoustic tracking in the lower Willamette River system. The experimental design involved deployment of a receiver array and fixed tags at two sites (Willamette Cove and RM 11.5 East [E]) where resident SMB had previously been caught. Each site has unique acoustic properties based on bathymetry, bottom sediment composition, anthropogenic alteration, and noise; Willamette Cove was a more quiescent location and RM 11.5E a more active location with regard to boat traffic. The pilot study design was developed with the input and assistance of Karl Gustavson of EPA’s Office of Superfund Research and Technology Innovation.

Each array consisted of five autonomous receivers deployed in a pattern designed to optimize detection and two-dimensional positioning of acoustic transmissions (quadrilateral with a central node). The distances of the quadrilateral nodes were within the detection specifications of each vendor’s equipment (≤ 150 meters [m]). A receiver from each vendor was installed on the same

mount that was securely moored such that the receiver was located about 1 m above the river bottom. Lotek tested their model WHS 4250 datalogger/receiver, which is a 416.7 kHz system. HTI-Vemco tested their model VR2 receiver which is a 180 kHz system. Three transmitters representing "tagged fish" were also deployed in stationary positions in optimal, less optimal, and sub-optimal locations relative to the receiver array. Lotek tested their JCART model 14-12 tag (combined acoustic and radio) and HTI-Vemco tested their V9 acoustic tag. All tags were set to a transmission interval of 3 seconds. The fixed receivers and transmitters were deployed for 1 week and then recovered. Tag transmission distance and positioning from the receiver array were also tested using mobile transmitters towed behind a vessel. Based on the transmission detections recorded during the pilot study, the detection efficiency and position efficiency and accuracy of each system was determined.

Overall, the detection efficiency and position efficiency and accuracy of the HTI-Vemco system was higher (AECOM 2017b).¹ Tag detection was recorded by the HTI-Vemco system at distances up to 400 m in Willamette Cove and 250 m in the noisier RM 11.5E area. Based on the pilot study, arrays with HTI-Vemco receivers spaced between 150 to 250 m (or more, depending on the site characteristics) are expected to provide reliable detection capability for fine-scale positioning of SMB. For detection only of tagged fish passing through a gate, receiver spacing of at least 200 m is expected to provide very high levels of detectability and trackability.

2.2 Rationale for Array Locations/Layout

The positioning of individual receivers is based on the physical configuration of the lower Willamette River, water depth (Figure 2), historical knowledge of contaminated areas at the Site, and the project objectives (Section 1.2). Lessons learned from the June 2017 pilot study also contributed to the design of the receiver array (AECOM 2017b). A total of 34 HTI-Vemco VR2 acoustic receivers will be installed in the river as part of this study. The layout of the acoustic receiver array will be a combination of "gates" (designed to track fish presence/absence) and more closely spaced receiver positions designed to track fine-scale fish movement in specific areas of interest.

A series of gates consisting of transects of two to three receivers will be installed at each river mile between RM 5 and RM 9 (Figure 3). These gates will track fish movement on a river mile scale in a section of the river that is representative of conditions and SMB habitat across the PHSS. Focusing on the four mile stretch in the central part of the Site also minimizes potential for tagged fish to leave the study area especially early on in the study. Gates will also be installed at the PHSS boundaries (RM 1.9, RM 11.8, and the mouth of Multnomah Channel) to track fish that enter or leave the study area. Three receivers will be deployed along each transect, except at RM 7, RM 8, and Multnomah Channel, where two receivers are expected to be sufficient due to the smaller river width, for a total of 21 receivers at the eight transects of gates. Based on the pilot study, the receivers within each transect will be spaced approximately 200 to 250 m apart.

¹ An equipment malfunction (SD card failure) in the Lotek receiver located in the central node of the Willamette Cove array compromised the detection capability of the Lotek system in this location.

To capture fine-scale fish movement, receiver arrays will also be installed in three areas of interest: Willamette Cove (RM 6.8 [four receivers]), Swan Island Lagoon (RM 8 [five receivers]), and near the Cargill/Glacier terminals (RM 11.5E [four receivers]). These three focused locations provide a range of SMB habitat and acoustic environments within the PHSS and represent areas of elevated COCs in sediment and SMB. The receiver layouts at the focused locations are shown on Figure 4 (Willamette Cove), Figure 5 (Swan Island Lagoon), and Figure 6 (RM 11.5E). Based on the pilot study, the receivers within each fine-scale array will be spaced approximately 150 to 200 m apart. The proposed receiver location coordinates are presented in Table 1 (final positioning will change based on the specific locations where receivers are deployed).

The combination of RM and fine-scale acoustic tracking of SMB over the year-long study duration (discussed in Section 2.6) is expected to provide a robust and representative dataset for characterizing the seasonal movement and home range of SMB throughout the PHSS.

2.3 Tagged Fish

The SMB has been selected as the species of interest for this study, as it is a prevalent, resident species with a smaller home range than other species included in the BHHRA (Kennedy/Jenks 2013a; Windward 2015). Further, a robust historical dataset on this species exists, making the SMB a good target for tissue monitoring (Section 2.1.1). A sample size of 40 tagged fish was selected for the PDI study. This number is sufficient to generate a robust dataset, even if some fish are lost over the course of the study. Consistent with the PDI SMB tissue study, SMB that are 225 to 355 millimeters in total length (approximately 9 to 14 inches) will be targeted, with a preference for larger specimens. To the extent practicable, the weight of the tag (in air) will be in the range of 2-5% of the total fish body weight, but not exceed 10% of the total body weight (Adams, et al 1998; Brown, et al, 1999). The HTI-Vemco model V9 tag, with a weight of 3.7 grams, will be used. Achieving a tag-fish weight ratio of less than 10% is not expected to pose a challenge based on the weight of SMB specimens caught during several prior sampling programs in the Study Area, as summarized in the table below.

Study	Sample Size	SMB Body Weight		
		Minimum (g)	Maximum (g)	Mean (g)
2012 SMB Study	92	85	660	350
2011 SMB Study	68	140	790	377
2007 RI Sampling for SMB	136	134	1035	344

2.4 Targeted Fishing Locations

Collection of fish for the study will be targeted between approximately RM 5 – RM 9 and within the three targeted areas (Willamette Cove, Swan Island Lagoon, and RM 11.5E). Maps from historical fish sampling efforts as well as institutional knowledge of the Oregon Bass and Panfish Club will help guide sampling efforts. Angling efforts will be focused on locations that were

productive in prior sampling events, as shown in Figure 7 (Integral 2008; GSI 2012; Kennedy/Jenks 2013b). It is anticipated that the fish collected for this effort will be representative of the resident population in the PHSS.

2.5 Sample Nomenclature

Both the acoustic receivers and the tagged fish will have a unique identifying sample identification number (ID) that includes the following, as described in the project-specific QAPP:

- Project phase (PDI)
- Sample matrix (AR [acoustic receiver] and AT [acoustic tagged fish])
- Sample type (A [acoustic receiver] and SMBT [tagged smallmouth bass])
- Unique, sequential station number (001 to ### per sample)

For example, acoustic receiver #32 would have the sample ID PDI-AR-A032, and the SMB implanted with tag #40 would have the sample ID PDI-AT-SMBT040.

2.6 Schedule

The fish tracking study is scheduled to begin in April 2018 with deployment of receivers and fish tagging to take place over a period of approximately two to three weeks. Receivers will be checked monthly for operational status using a topside transponder. Data downloads are scheduled for 3 months, 6 months, and at the conclusion of the study in late March/early April of 2019. It is anticipated that the results of the 3-month data download (July 2018) will be used to inform the SMB sampling program scheduled for August/September 2018. Telemetry equipment retrieval will take place at the conclusion of the study in spring 2019.

3. PROJECT ORGANIZATION/FIELD TEAM

3.1 Team Organization and Responsibilities

EPA is the lead agency overseeing the work. The EPA Project Manager is Mr. Davis Zhen. EPA will be assisted in the review of technical documents by an oversight contractor.

Team organization is presented in detail in the PDI Work Plan and in Section 2 of the QAPP. As it relates to this FSP, AECOM is coordinating activities, including management of all subcontractors, field sampling, analysis, and reporting scoping tasks.

The PDI Project Coordinator, Mr. Ken Tyrrell, and PDI Project Manager, Dr. Jennifer Pretare, Ph.D. (AECOM), will be responsible for overall project coordination and providing oversight on planning and coordination, work plans, all project deliverables, and performance of the

administrative tasks needed to ensure timely and successful completion of the project. Ms. Betsy Ruffle (AECOM) will serve as the senior technical lead for this study.

Ms. Nicky Moody (AECOM) and Mr. Keith Kroeger (Geosyntec) will be the Project Field Coordinators (FCs) and will be responsible for managing field activities and general field quality assurance/quality control (QA/QC) oversight. The fish tracking task will be led by Mr. Ryan McCarthy (AECOM), who led the pilot study, with support from Mr. Steve Pagliughi, an AECOM senior fishery biologist with extensive experience with SMB and fish telemetry studies.

Ballard Marine Services (Ballard), of Washougal, Washington, will provide vessel support during the deployment of the acoustic moorings and monthly field checks, with Mr. Robert Stanton acting as the point of contact. Gravity Marine Services (Gravity), of Fall City, Washington, will provide vessel support during fish collection and tag implant, with Mr. Shawn Hinz acting as the point of contact. HTI-Vemco of Seattle, Washington, will provide telemetry support, including provision of telemetry equipment, supporting receiver deployment and tag implantation, and performing preliminary post-processing and data analysis. Mr. Sam Johnston will serve as the HTI-Vemco point of contact. Both Ballard and HTI-Vemco participated in the pilot study. Dr. Christa Woodley, Senior Aquatic Biologist with the U.S. Army Corps of Engineers Engineer Research and Development Center, who also participated in the pilot study, will provide expert assistance and review.

3.2 Communication/Information Flow

The communication strategy is outlined in Section 2 of the QAPP. The FC will be the point of contact for field staff during the implementation of this FSP. Deviations from this FSP or the project-specific QAPP will be reported to the PDI Project Coordinator for consultation. Significant deviations from the FSP/QAPP will be further reported to representatives of the Pre-RD AOC Group and EPA.

3.3 Coordination with EPA

The PDI Project Coordinator will notify the EPA Project Manager 1 week prior to beginning any field activities so that EPA can schedule any oversight activities required. The PDI Project Coordinator will also notify the EPA Project Manager once field activities have been completed.

4. FIELD WORK TASKS AND PROCEDURES

The following sections describe the procedures and methods that will be used during the acoustic fish tracking study. These procedures include receiver/mooring deployment, fish collection, tag implantation, data downloading, and mooring recovery activities, as well as recordkeeping and field quality control procedures. It is currently anticipated that this work will commence in April 2018 and will be 1 year in duration. All field work will be conducted in accordance with the project-specific Health and Safety Plan (AECOM and Geosyntec 2018b). Standard Operating Procedures (SOPs) associated with the fish tracking program are provided in Appendix A.

4.1 Sampling Vessels and Equipment

Fish collection activities will be performed on vessels provided by a subcontractor (Gravity, supported by the Oregon Bass and Panfish Club). These boats will be equipped with aerated livewells in order to store/transport fish between the collection site and the landside surgery station (location to be determined pending site reconnaissance).

Receiver mooring deployment, data download, and recovery activities will be performed on research work vessels provided by Ballard. The vessels will provide a wide, stable platform and be equipped with a davit arm suitable for safely lifting and deploying heavy loads (e.g., 100 pounds). Monthly routine monitoring may be performed using smaller vessels, depending on availability and river conditions.

4.2 Permits/Notifications

The study will involve the collection of approximately 40 SMB using hook-and-line methods, surgical implant of an acoustic tag, and subsequent release back to the river following a recovery period. All non-target sized SMB or other fish incidentally captured will be immediately and safely returned back to the river.

The lower Willamette River supports five federally threatened salmonid species that could be incidentally captured during hook-and-line fishing. Section 4(d) of the Endangered Species Act directs the National Marine Fisheries Service to issue authorizations for scientific research projects that may result in incidental take (harm or harassment) of federally threatened species. The ODFW also requires a scientific taking permit to collect fish from the waters of the state for scientific purposes. However, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 121(e)(1) and the National Contingency Plan (40 CFR 300.400(e)(1)) exempt the requirement for federal, state, or local permits for on-site response actions conducted pursuant to CERCLA. The AECOM PDI Project Coordinator and/or PDI Project Manager will coordinate with the EPA Project Manager to determine what permit equivalencies are required for this study.

4.3 Station Positioning/Navigation

The Ballard research vessel will navigate to each proposed mooring location using a differential global positioning system (DGPS) unit with an accuracy of 1 to 2 m. The DGPS accuracy will be confirmed each morning and evening to a known land-based survey point. Confirmed deployment locations will be recorded to the nearest whole international foot in North American Datum 1983 (NAD83), National Spatial Reference System (NSRS) 2007. Once the vessel has navigated to the proposed deployment location, the field team will visually confirm the location and surroundings against the proposed receiver array maps (Figures 3 through 6) prior to deployment. The locations depicted on the figures are approximate, as actual deployment locations will be dictated by conditions encountered in the field.

4.4 Acoustic System Components

The major components of the acoustic system are the HTI-Vemco Model HR2 receiver and the Model V9 tag (180 kHz). The internal clocks in receivers will all be synchronized to an external GPS receiver prior to deployment. The HTI-Vemco HR2 receivers are expected to have sub-meter positional accuracy.

The acoustic receivers will be mounted to fixed moorings placed on the bottom of the lower Willamette River (Figure 8). The bottom mounts will be fabricated prior to the commencement of the study. The mooring platforms will consist of a purpose-built metal frame that has been designed for easy deployment and retrieval of the system (Figure 9). A ground line will be attached as a backup in the event that an acoustic release fails or is damaged. If determined to be practical, the ten bottom mounts that were used for the 2017 Pilot Study may be reused for this study. These moorings will be outfitted with an acoustic release for periodic downloading and maintenance.

In the three focus areas (Willamette Cove, Swan Island Lagoon, and RM 11.5E), the receivers in each array will be anchored to the bottom and have a tethered cable to shore, given the proximity to shore and assuming property access agreements are obtained. The final locations of the cabled receivers will be confirmed after a Site visit and final approval(s) of property access.

4.5 Mooring/Receiver Deployment

Receivers will be attached directly to the moorings and configured to have the receiver submerged approximately 1 m above the river bottom such that it will not be damaged by vessel traffic or impede navigation. Each mooring will have a submerged float, which will aid in retrieval. The on-deck davit on the research vessel will be used to hoist the mooring and gently place it on the river bottom. The receiver mount system was successfully used in the 2017 pilot study and was effective in terms of performance, security, and safe deployment/retrieval.

Once the receivers have been deployed, a test acoustic transmitter will be towed through the acoustic array to ensure that all receivers are functioning properly and demonstrate that no critical gaps in the field of detection are present. Additionally, the receiver moorings will be checked for tilt, to ensure that they are sitting flat on the river bottom and have not been deployed on a slope or fallen over. Receiver locations will be modified as needed in order to achieve the desired coverage and to optimize detection resolution in specific areas.

The location of each receiver will be surveyed using a DGPS when deployed. These station positions will be recorded on the pre-deployment checklist (included in Appendix B). Each time a receiver is recovered for download or replaced, the field team will resurvey the receiver's location.

4.5.1 Monthly Field Checks

Acoustic receivers will be checked for presence, maintenance, and functionality approximately once every month. A Ballard vessel will be used for this task. The receiver's internal transponder allows for remote monitoring of tilt, temperature, battery level, available storage space, and noise levels, reducing the number of times the receiver needs to be hauled to the surface for operational checks and redeployed with new GPS coordinates. A surface communication deck box will be used for remote communications with the deployed receivers.

4.5.2 Data Downloading

Acoustic receivers will be manually retrieved, and acoustic data from the receiver will be downloaded directly via USB cable to a field computer. The receivers will be evaluated for functionality and cleared of any biofouling growth. Acoustic receivers will also be visually examined for any obvious defects or necessary repairs, and batteries will be replaced. Data downloading will be performed at 3 months, 6 months, and at the conclusion of the study (12 months). Upon re-deployment, a new GPS station position will be recorded. Once the maintenance check has been performed and the data have been downloaded, the field team will proceed to the next acoustic receiver until all receivers have been visited. Once data has been retrieved, it will be managed according to the project Data Quality Management Plan (DQMP; AECOM and Geosyntec 2018c).

4.5.3 Mooring/Receiver Recovery

At the conclusion of the study, all receiver/moorings will be collected from the river bottom. It is not anticipated that any equipment will be left behind. If the acoustic releases do not actuate, a grapple hook will attempt to snag the ground/back-up line attached to the receiver mooring.

4.6 Fish Collection and Tagging

4.6.1 Fish Collection

Fish for acoustic tagging will be collected by hook-and-line angling techniques using artificial lures. Contract anglers from the Oregon Bass and Panfish Club will be employed to capture SMB. Each subcontracted angler vessel will be outfitted with a GPS to record capture locations and an onboard or side-mounted tank or "livewell" for transporting/holding caught SMB. A maximum of four SMB will be permitted in a livewell at any given time. Each livewell will be filled with river water that is kept aerated, cleared of all potential snags, and cooled (if necessary). This will keep the fish alive after capture so the fish can be safely transported to the surgery station. Fish will be carefully handled and cared for prior to and after surgeries.

A fish collection datasheet (including GPS coordinates at capture location) will be filled out immediately after a candidate specimen is captured (sheets are presented in Appendix B). Each fish will be given a unique sample ID on the fish collection datasheet, and this number will be used to name the capture location point file. Sample identification nomenclature will follow the

guidelines detailed in Section 2.5 of this FSP and the SOPs in Appendix A. After a fish is surgically implanted with an acoustic tag at the surgery station (Section 4.6.2), the tag code and sample ID will be recorded on the fish collection datasheet in order to link the tag code to the collection location. Therefore, it will be necessary to be able to identify each captured individual between the time of capture and the time of acoustic tag implantation. Maximum total length, fork length, (in millimeters) and weight (in grams) will also be recorded on the fish collection datasheets immediately after capture to identify individuals. This approach will allow identification of individuals and eliminate having to mark or attach a numbered culling buoy to each individual, thus avoiding potential marking injuries that may affect post-release survival and behavior. Pre- and post-surgery livewells will also have unique IDs so the fish can be accurately tracked through the surgery and eventual release.

Landing nets will not be used to land fish in order to avoid potential injuries to captured fish and maintain tagging candidates in the best possible condition. Captured SMB having hooking or other injuries and/or displaying obvious abnormal behavior (e.g., sluggishness, erratic swimming) will be immediately released and will not be implanted with an acoustic tag. Abnormal behavior will be determined by the best professional judgement of the on-site fisheries biologists. If at any point abnormal behavior is observed, the fish will be sacrificed and the fish will be retained for potential chemical analysis (Section 4.6.4 below).

The fish collection standard operating procedure (SOP) is provided in Appendix A.

4.6.2 Acoustic Tag Implantation

Surgical implantation will be performed by HTI-Vemco field biologists experienced in acoustic fish tag implantation procedures with assistance from AECOM biologists. A secure, land-based surgical station will be established prior to the commencement of the study and will be assembled and disassembled each day. The surgery station will be located in an upland area with ready access to the river. Holding pens/livewells will be on-site to retain fish prior to surgery, during recovery, and before release.

A portable electronarcosis system will be utilized by HTI-Vemco field biologists to anesthetize SMB during surgical implantation procedures. The electronarcosis system consists of a modified 153 liter marine cooler, fish cradle, and a variable power generation system. The electronarcosis system is based on designs described in Hudson et al. 2011. Prior to being placed in the electronarcosis system, each SMB will be photographed and have scales removed for age dating. Scales will be removed from the area posterior to the pectoral fin and slightly below the lateral line (DeVries and Frie 1996); scale samples will be placed in wax paper, and placed in a coin envelope with the sample date and associated sample identification number clearly written on the outside of the envelope.

Each SMB will be placed ventral side up in the cradle within the electronarcosis system with the anterior end of the fish pointed towards the anode. SMB will be submerged deep enough in the water to cover the gills. Multiple aquarium bubblers will provide and maintain adequate

dissolved oxygen (DO) levels during surgery. An on-site fisheries biologist will monitor DO levels in the livewells and will record this information on the datasheets. Maintaining the oxygen level near saturation in the surgery station livewell potentially results in higher blood oxygen levels during anesthesia which aids in post-surgery recovery (Itazawa and Takeda 1982). Using a DC power supply, voltage will be slowly increased until induction (surgical anesthesia) is achieved (Sladky et al. 2001; Coyle et al. 2004).

Prior to and after each surgery, acoustic tags, hemostats, sutures, and scalpels will be disinfected. Following a small incision in the midline area, a pre-programmed HTI-Vemco Model V9 acoustic tag will be activated and inserted through the incision and into the abdominal cavity. Each acoustic tag will be programmed with a unique code/number in order to identify the individual fish, and the acoustic tag code/number will be recorded on the fish collection datasheet. After tag insertion, the incision will be closed with two simple interrupted sutures. A small external tag (T-bar tag or equivalent) will be attached to the SMB just behind the dorsal fin, and the SMB will be removed from the electronarcosis system, placed in a well oxygenated recovery livewell, and carefully observed for post-surgery behavior. SMB should fully recover within 2 minutes after being removed from the electronarcosis system; each surgical procedure will take approximately 30 minutes.

The tag implant SOP is provided in Appendix A.

4.6.3 Fish Recovery/Release

Tagged fish will be placed in an aerated recovery tank for at least 2 hours and up to 1 day prior to release to ensure that there are not any post-surgery complications or mortalities. Tagged fish that regain equilibrium and exhibit controlled movement will be released. To the extent practicable, fish will be released back into the river in the vicinity of where they were originally caught. The coordinates of the release location for each fish will be recorded on the field data sheet.

4.6.4 Fish Mortality

To the extent practicable, every attempt will be made to prevent any inadvertent mortalities of SMB captured and/or tagged during the study. However in the event that a mortality does occur, the fish may be considered for tissue chemistry analysis as part of the baseline fish tissue sampling described in the Fish Tissue FSP. In this case, the individual fish will be wrapped in aluminum foil, labeled, and placed in a gallon-sized, zip top bag. Fish collected in this manner will be submitted to the project selected analytical laboratory for cold storage (+/- 4°C) until a decision can be made regarding analysis. The data necessary for including the fish as a future tissue chemistry sample (e.g., location captured, size, age, etc. per the Fish Tissue FSP) will be recorded in order to ensure that DQOs are met.

4.7 Decontamination

The physical environment implantation surgeries are performed in is an important consideration that determines the quality and success of the procedure. The surgical environment will be

maintained in a sterile condition throughout all procedures. The surgical station will be intermittently cleaned and wiped down with a solution of disinfectant; reusable surgical instruments will be placed in a disinfectant bath before and after surgical procedures. Surgical instruments will be transferred to a freshwater rinse bath before surgery. All equipment used for capture, holding, anesthesia, surgery, recovery, and movement of fish during the project will be thoroughly cleaned and disinfected to minimize the potential for any biological interferences.

4.8 Management of Investigation-Derived Waste

Fish collected but not retained for surgery will be returned to the lower Willamette River area from which they were collected or sacrificed and retained for potential chemical analysis. Water used for decontaminating the sample processing equipment will be collected and then returned to the lower Willamette River. Only biodegradable, phosphate free detergents will be used for decontamination (e.g., Liquinox®). Other consumables such as disposable sampling equipment, fish surgical tools, and gloves will be bagged for disposal and managed as a solid waste and discarded as general municipal waste. A disposable sharps container will be on-site for safe collection/disposal of any sharps waste.

5. DATA MANAGEMENT AND REPORTING

All data management will be performed according to the QAPP and DQMP.

5.1 Field Documentation and Reporting

A bound field logbook will be assigned to and maintained by AECOM field team members to provide daily records of significant events, observations, and measurements during the field effort. Each page will be numbered, signed, and dated. These logbooks will be kept as permanent records. Complete field record keeping details can be found in the project QAPP (AECOM and Geosyntec 2018).

A brief activity log will be filed with the FC at the completion of each working day. This log will summarize the work activities undertaken/completed each day, progress, personnel on-site, hours worked, health and safety concerns, and any technical issues encountered. Field logbooks and field data sheets completed during fish collection and implantation activities will be scanned and emailed to the Technical Lead at the conclusion of each working day (or as soon as practically possible).

5.2 Data Processing

The fish tracking data collected from the acoustic receivers during the study will be provided in raw and data-processed formats. The data will be compiled and processed using HTI's software (Acoustic Tag Software Suite and MarkTags) in order to identify valid tag returns within the raw data. The valid detections will then be compiled into a single detection history for each fish. This detection history will be further processed to identify false/erroneous events to remove spurious

data points. Once the data are processed and proofed, the data will be used to create fish tracks/positions (where possible). The gated portion of the system can only provide a presence/absence data point and indicate whether a fish was within the receiver detection range. The post-processed data sets from the high-resolution and gated receivers will be combined and imported into a Microsoft Access database.

5.3 Quality Review

A series of QA/QC steps will be implemented to ensure data integrity. Monthly checks of the receiver network will be performed to ensure system functionality and proper data collection. The data will be processed on HTI's software (Acoustic Tag Software Suite and MarkTags) to evaluate the data for accuracy/usability. If problems with the systems are detected/identified during the monthly checks, they will be corrected using remote access to the collection equipment, or field crews will be dispatched as soon as possible to visit the site and correct the problems.

5.4 Reporting Frequency

Brief field summary reports will be provided to EPA following the 3-, 6-, and 12-month data downloads. Equipment specifications including system and tag operating parameters, calibrations, and results of pre-installation testing will be included in the summary reports. Methods, analyses, and results for all testing procedures including establishing range and efficiency calculations will be documented and presented in standard scientific reporting format.

The overall results of the study will be discussed and presented in a final report that will specifically address the key questions identified in the study objectives in Section 1.2, identify plan deviations, and summarize field collection activities.

5.5 Plan Deviations

Deviations to this FSP potentially include the monitoring of alternate stations or scope reductions/enhancements related to site conditions or real-time information. Safety will be given the highest priority in all aspects, and the Field Coordinator will be responsible for documenting all plan deviations and contacting the Project Technical Lead or PDI Project Manager to discuss these at the earliest convenience, preferably before deviations are undertaken, if possible.

5.6 Data Management and Retention

All related documentation is to be maintained in the project file either in electronic or hardcopy form. All hardcopy records will be maintained in the project file; all electronic records will be maintained in project-specific directories within AECOM's network and a final Electronic Data Deliverable will be provided to EPA at the conclusion of the PDI study.

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TABLES

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Table 1. Coordinates of Proposed Receiver Locations

	Proposed Location Coordinates (NAD 1983, Intl Feet) ^a	
Receiver ID	Easting	Northing
PDI-AR-A01	7617785	725573
PDI-AR-A02	7617159	725997
PDI-AR-A03	7616627	726410
PDI-AR-A04	7613373	720491
PDI-AR-A05	7613329	720241
PDI-AR-A06	7620316	711291
PDI-AR-A07	7619786	710986
PDI-AR-A08	7619351	710760
PDI-AR-A09	7623346	707348
PDI-AR-A10	7622976	706944
PDI-AR-A11	7622675	706598
PDI-AR-A12	7626823	705692
PDI-AR-A13	7626771	705455
PDI-AR-A14	7627349	705607
PDI-AR-A15	7627114	705360
PDI-AR-A16	7627510	704330
PDI-AR-A17	7627033	703825
PDI-AR-A18	7631922	701400
PDI-AR-A19	7631107	700551
PDI-AR-A20	7630513	699906
PDI-AR-A21	7632710	701760
PDI-AR-A22	7633412	701735
PDI-AR-A23	7633178	701324
PDI-AR-A24	7633956	701070
PDI-AR-A25	7635076	697378
PDI-AR-A26	7634788	696950
PDI-AR-A27	7634459	696383
PDI-AR-A28	7644382	688077
PDI-AR-A29	7644821	688359
PDI-AR-A30	7645142	687911
PDI-AR-A31	7644791	687638
PDI-AR-A32	7645511	687193
PDI-AR-A33	7645322	687027
PDI-AR-A34	7645129	686858

Notes:

a) Horizontal Projection: NAD 1983 Oregon State Plane North (Intl Feet)

Acronyms:

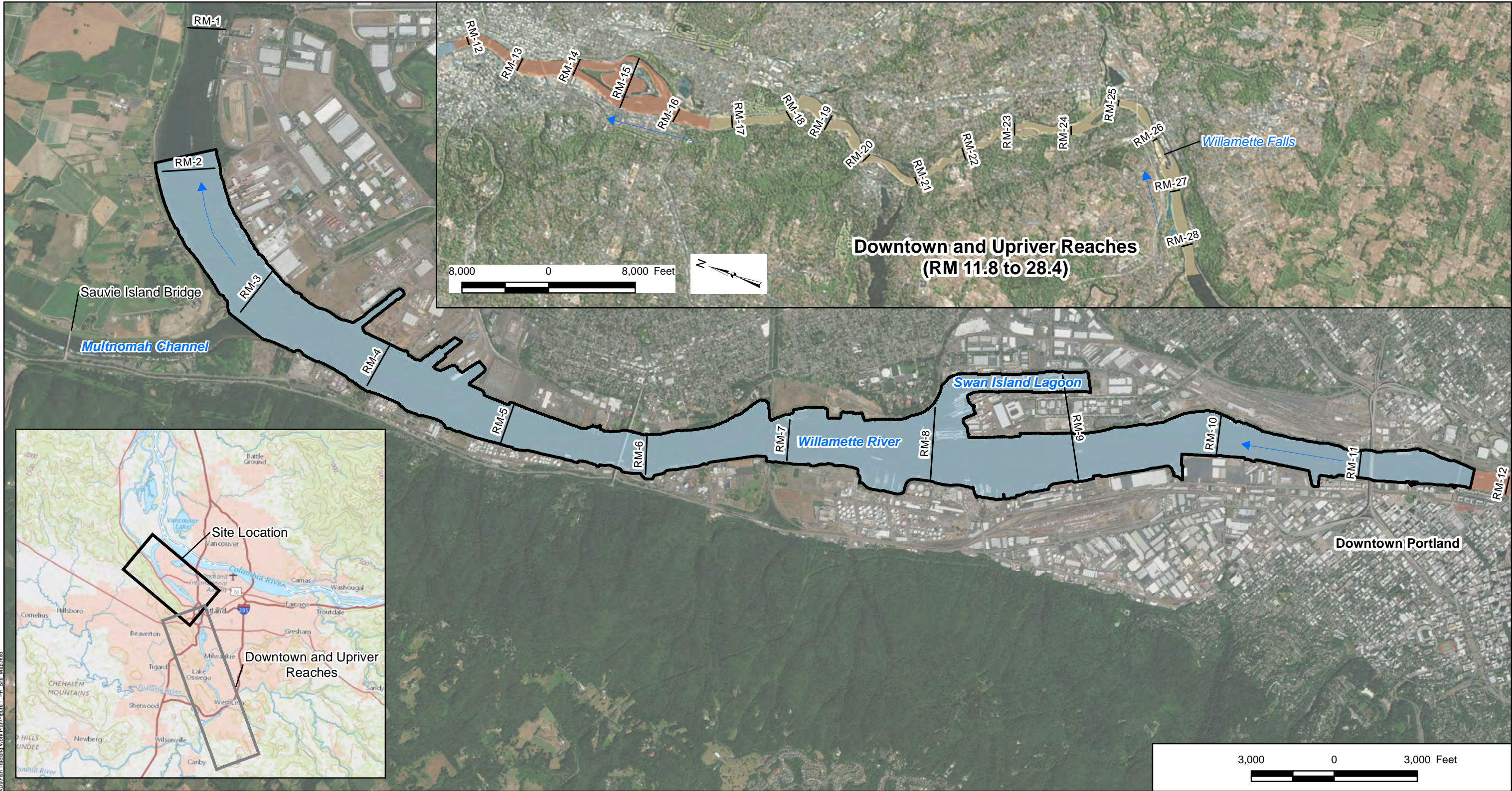
ID = identification number

NAD = North American Datum

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FIGURES

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Legend

Flow Direction

River Mile Marker

Superfund Site Boundary (RM 1.9 to 11.8)

Study Area

Site Area (RM 1.9 to 11.8)

Downtown Reach (RM 11.8 to 16.6)

Upriver Reach (RM 16.6 to 28.4)

Note:
1. Aerial Imagery provided by ESRI Basemaps 2016

Portland Harbor Site Map

Portland Harbor Superfund Site
PDI Fish Tracking FSP

AECOM

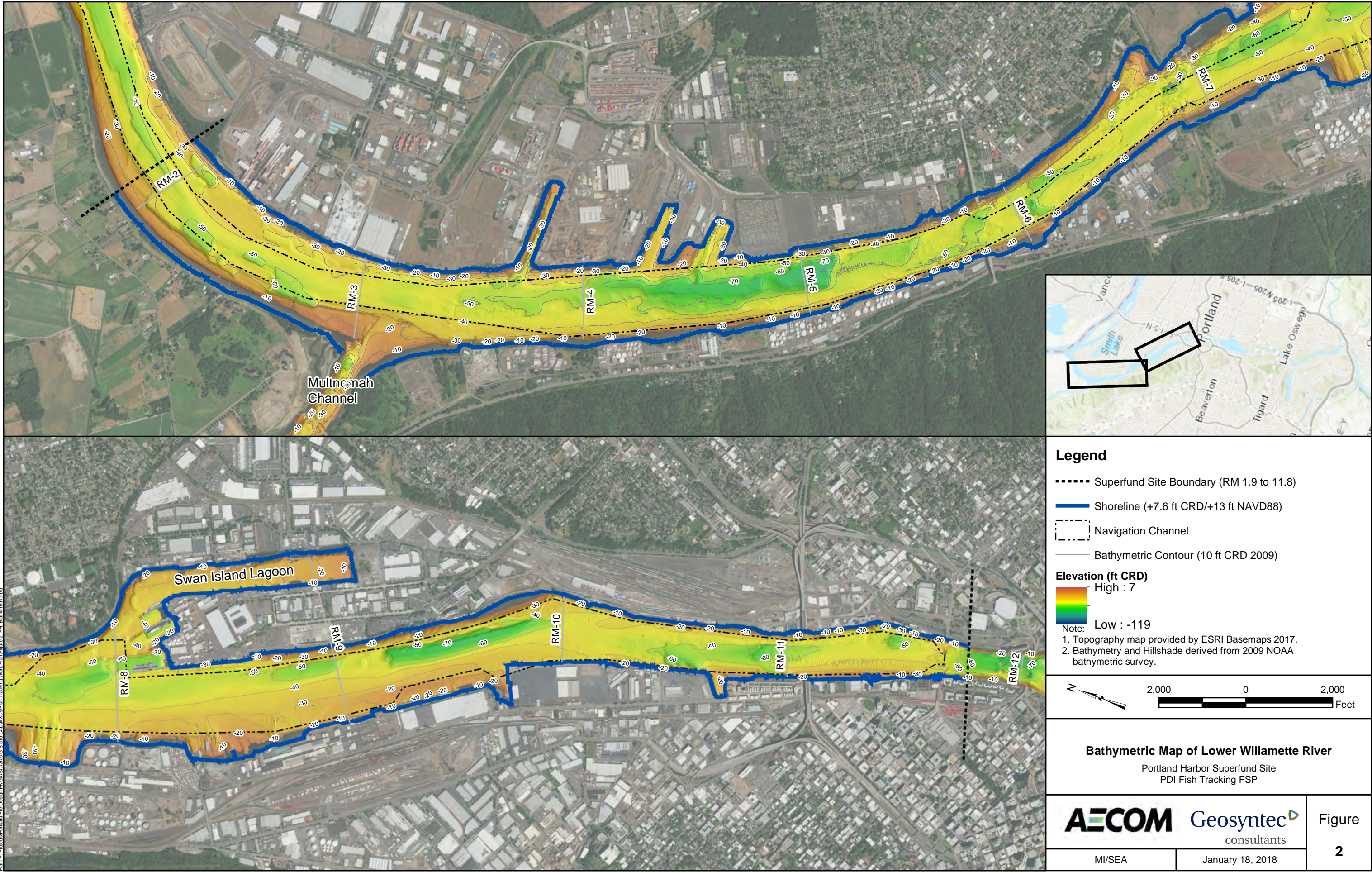
Geosyntec
consultants

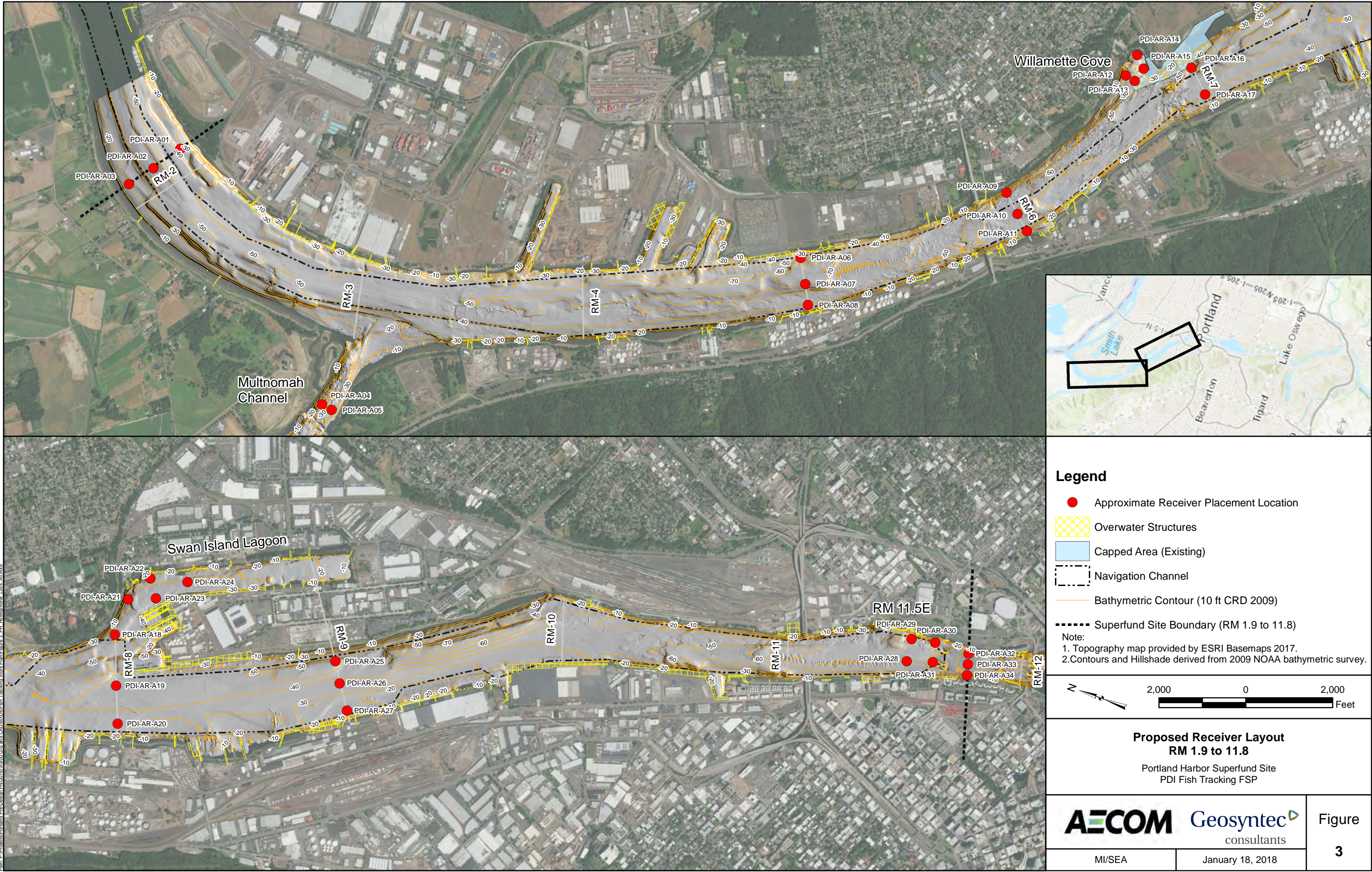
MI/SEA

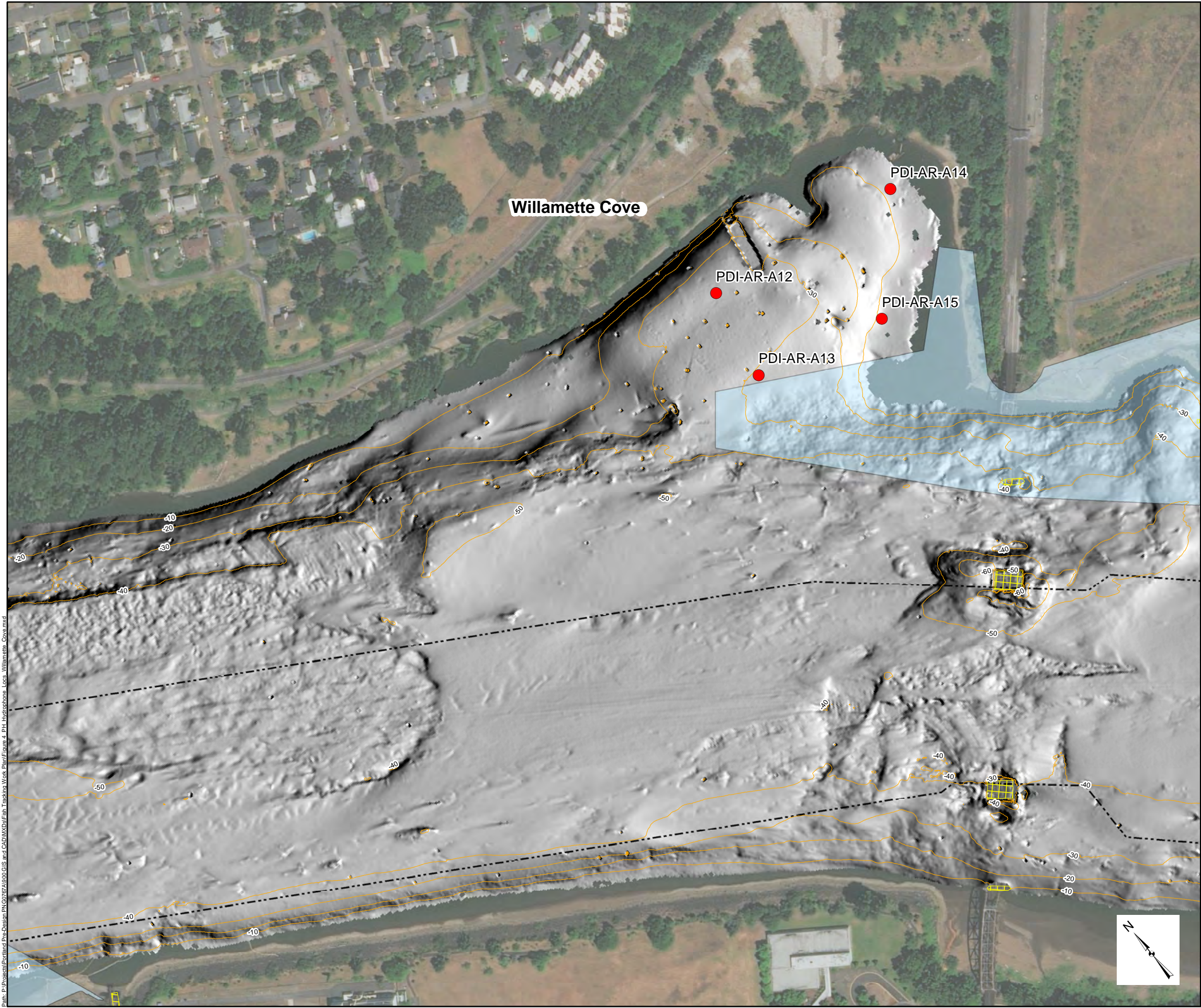
January 18, 2018

Figure

1







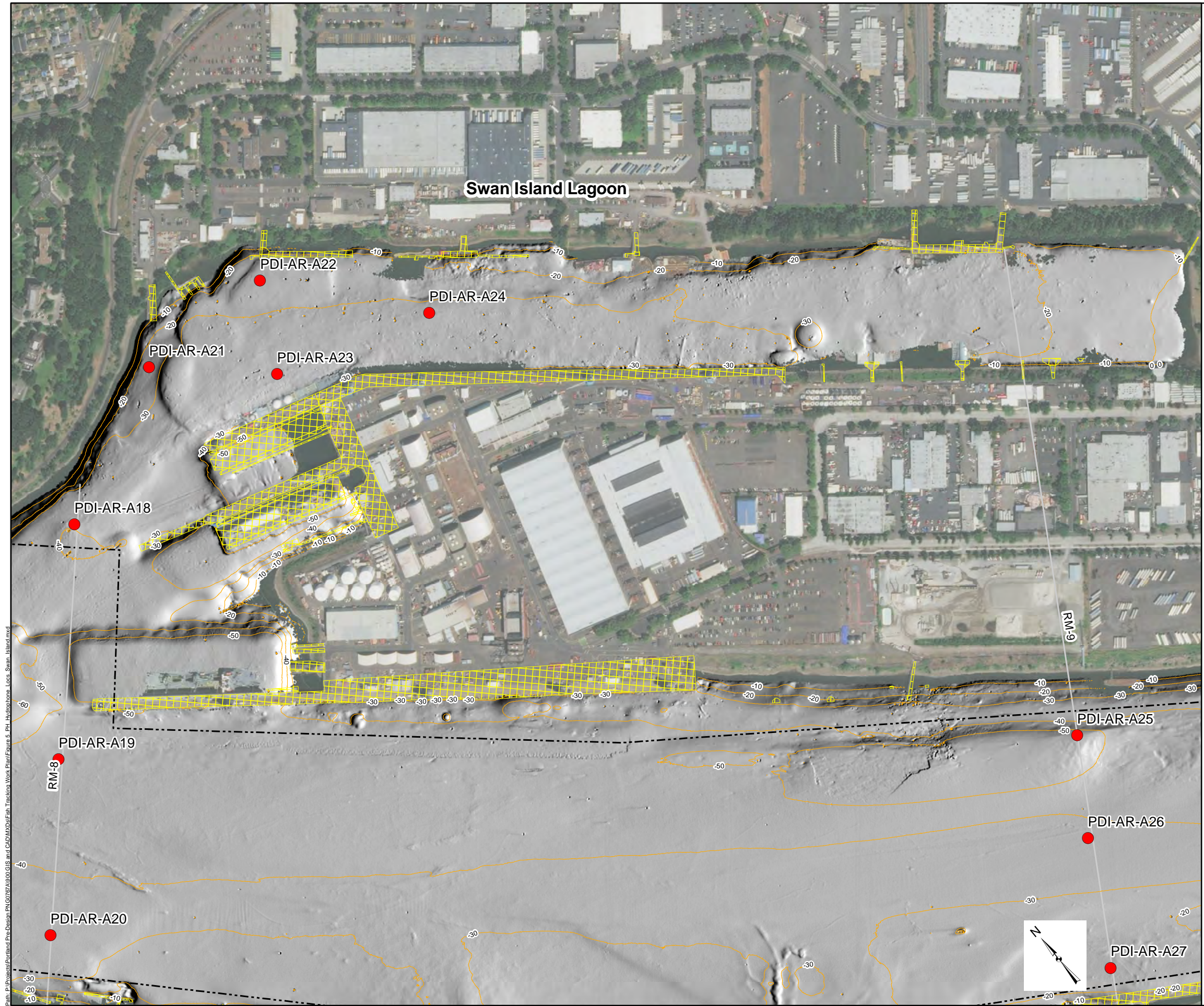
Legend

- Approximate Receiver Placement Location
- Overwater Structures
- Capped Area (Existing)
- Navigation Channel
- Bathymetric Contour (10 ft CRD 2009)

Note:
1. Topography map provided by ESRI Basemaps 2017.
2. Contours and Hillshade derived from 2009 NOAA bathymetric survey.



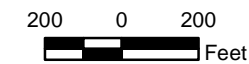
**Proposed Receiver Array Layout
Willamette Cove**
Portland Harbor Superfund Site
PDI Fish Tracking FSP



Legend

- Approximate Receiver Placement Location
- Overwater Structures
- Navigation Channel
- Bathymetric Contour (10 ft CRD 2009)

Note:
1. Topography map provided by ESRI Basemaps 2017.
2. Contours and Hillshade derived from 2009 NOAA bathymetric survey.



Proposed Receiver Array Layout Swan Island Lagoon

Portland Harbor Superfund Site
PDI Fish Tracking FSP

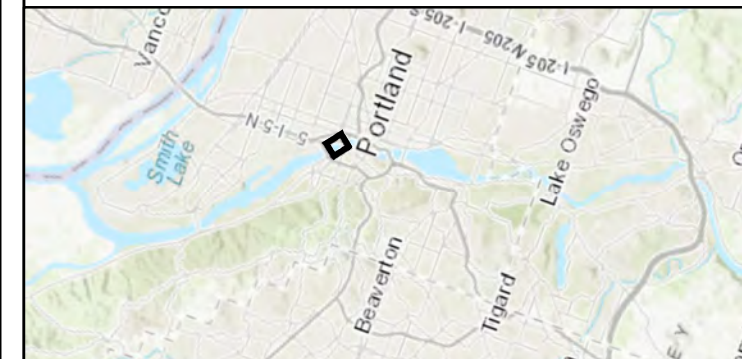
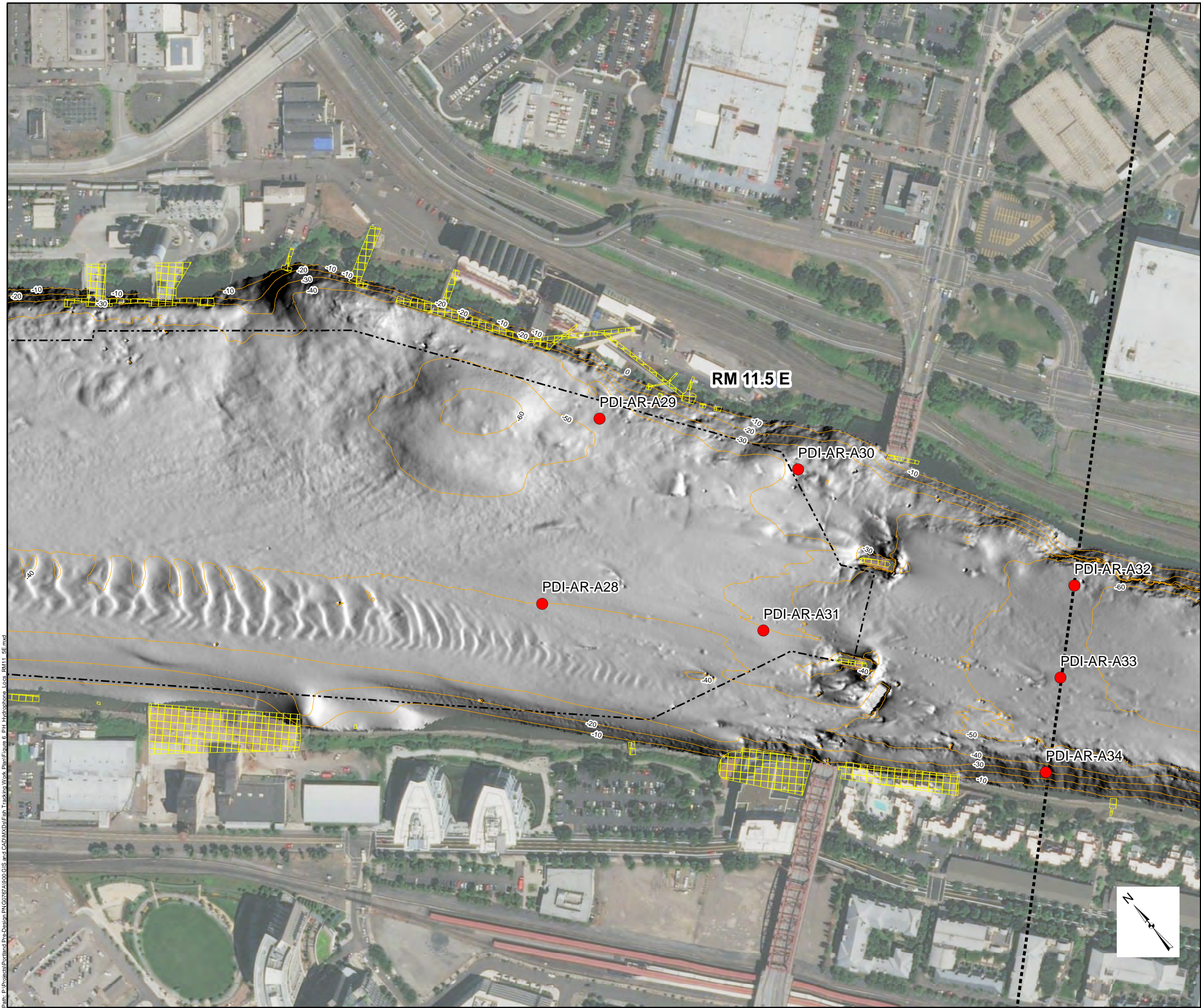


MI/SEA

January 18, 2018

Figure

5



Legend

- Approximate Receiver Placement Location
- Overwater Structures
- Navigation Channel
- Bathymetric Contour (10 ft CRD 2009)
- Superfund Site Boundary (RM 1.9 to 11.8)

Note:
1. Topography map provided by ESRI Basemaps 2017.
2. Contours and Hillshade derived from 2009 NOAA bathymetric survey.



Proposed Receiver Array Layout RM 11.5E

Portland Harbor Superfund Site
PDI Fish Tracking FSP



MI/SEA

January 18, 2018

Figure
6



- Legend**
- ★ 2012 Fish Tissue Sampling Location
 - ★ 2011 Fish Tissue Sampling Location
 - ★ 2007 Fish Tissue Sampling Location
 - Superfund Site Boundary (RM 1.9 to 11.8)
 - Alternative F Mod SMA Footprint

Note:

1. Aerial Imagery provided by ESRI Basemaps 2017
2. n - sample count, RM - River Mile, SMA - Sediment Management Area
3. Site defined as RM 1.9 to 11.8
4. The Downtown Reach is defined by EPA as extending from RM 11.8 to RM 16.6 and Upriver Reach is defined by EPA as extending from RM 16.6 to RM 28.4
5. The 2007 locations represent a central point for the individual specimens included in each composite

2,000 0 2,000 Feet	
Smallmouth Bass Catch Locations from Prior Sampling Events (RM 1.9 to 20) Portland Harbor Superfund Site PDI Fish Tracking FSP	
AECOM	Geosyntec consultants
MI/SEA	January 18, 2018

Figure
7

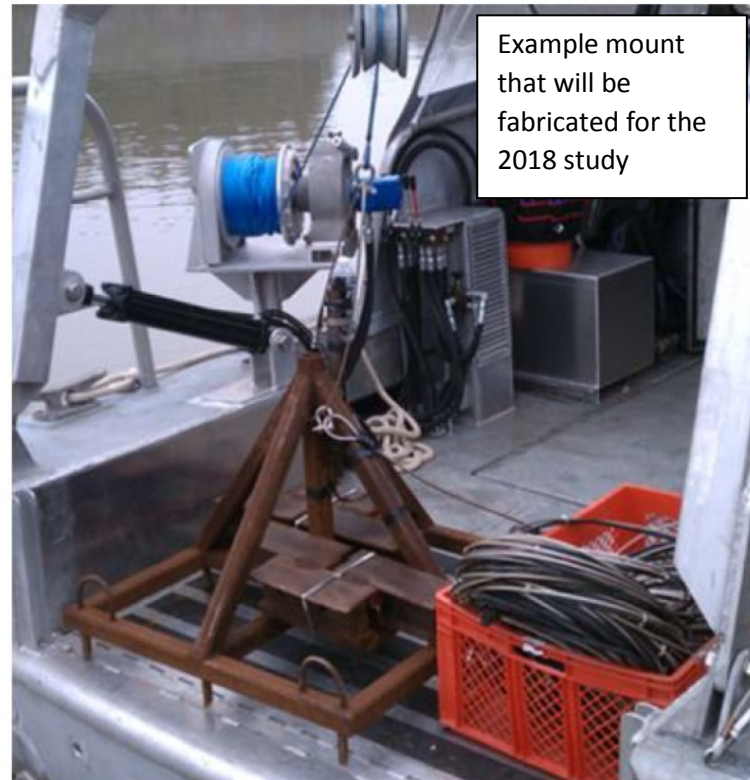


Figure 8. Acoustic Equipment Mount

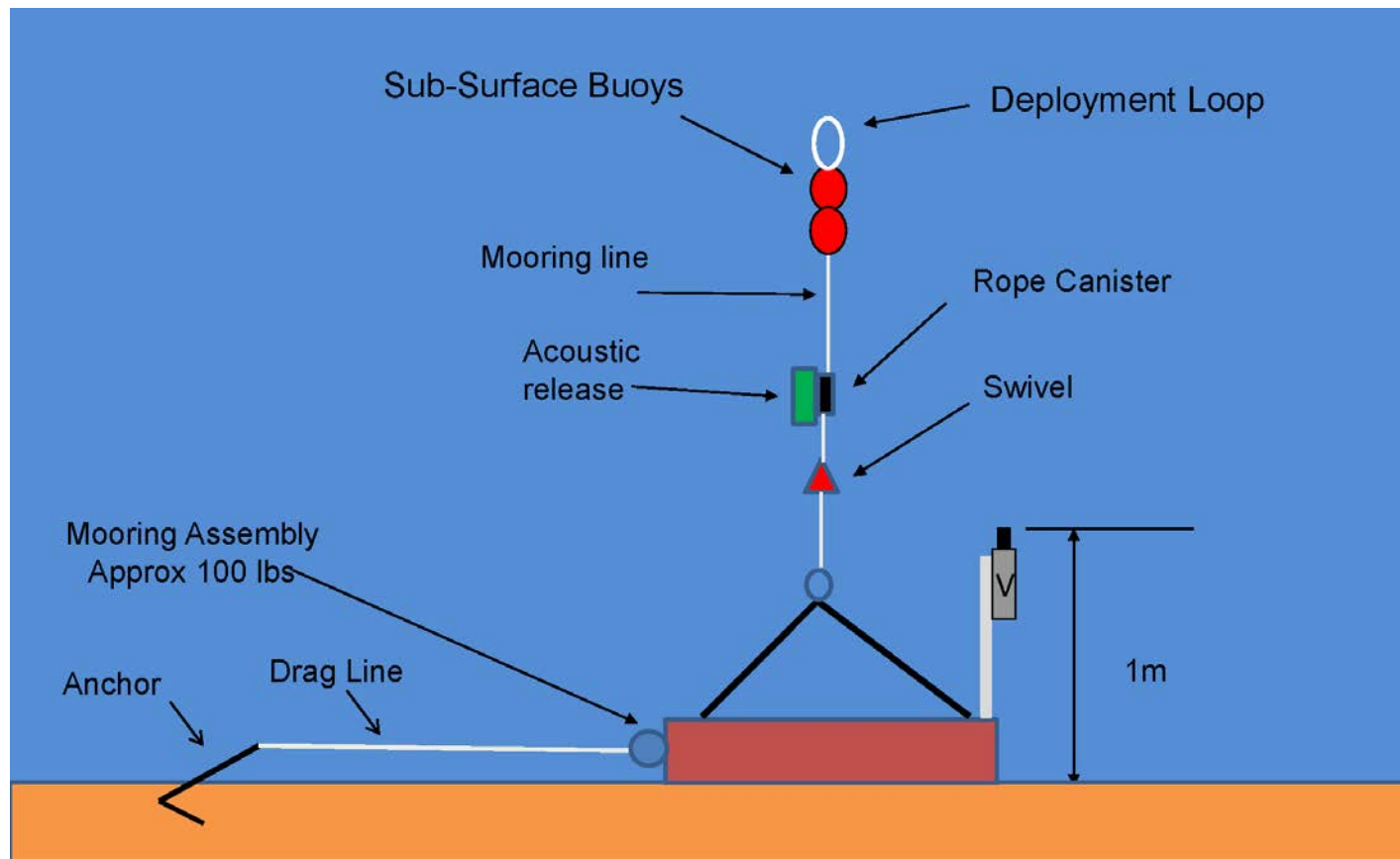


Figure 9. Acoustic Equipment Schematic

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Attachment B

Draft Fish Tissue Analysis Study Plan

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www.aecom.com

503-222-7200 tel
503-222-4292 fax

January 18, 2018

Mr. Davis Zhen, Project Coordinator
U.S. Environmental Protection Agency
1200 6th Avenue
Seattle, Washington 98101

Subject: **Portland Harbor Superfund Site
Pre-Remedial Design (Pre-RD) Investigation and Baseline Sampling
Fish Tissue Field Sampling Plan
CERCLA Docket No. 10-2018-0236**

Dear Mr. Zhen:

On behalf of the Pre-RD AOC Group, AECOM is pleased to submit the Fish Tissue Field Sampling Plan (FSP) in accordance with the Administrative Settlement Agreement and Order on Consent (ASAOC) for Pre-RD Investigation and Baseline Sampling.

The attached document describes the activities to be performed in compliance with the Statement of Work Section 3.1 "Scope of Pre-Remedial Design Investigation (PDI)" and Section 5.7(c) "Supporting Deliverables to PDI Work Plan" approved by the U.S. Environmental Protection Agency (EPA) as part of the ASAOC.

We understand the EPA has 30 days to review the attached document. In the interest of expediting the project, we encourage a meeting to assist with a timely review and approval process.

Again, on behalf of the Pre-RD AOC Group, we are pleased to submit the referenced document and look forward to assisting in the review process.

Sincerely,

Kenneth M. Tyrrell
AECOM Project Coordinator
Executive Vice President
(281) 224-2793

Copies: Pre-RD AOC Group, Mr. Hans Feige

AGENCY REVIEW DRAFT

Fish Tissue Field Sampling Plan

Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling Portland Harbor Superfund Site

AECOM Project Number: 60554349
Geosyntec Project Number: PNG0767A

January 18, 2018

Prepared for:

United States Environmental Protection Agency, Region 10
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101

On behalf of:

Portland Harbor Pre-RD AOC Group
Portland, Oregon

Prepared by:



111 SW Columbia, Suite 1500
Portland, OR 97201
USA
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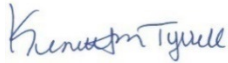
engineers | scientists | innovators

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CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.



January 18, 2018

Kenneth M. Tyrrell
PDI Project Coordinator
AECOM Technical Services

Date

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ACRONYMS AND ABBREVIATIONS

2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzodioxin
AECOM	AECOM Technical Services
ASAOC	Administrative Settlement Agreement and Order on Consent
BEHP	bis-2-ethylhexylphthalate
BHHRA	baseline human health risk assessment
COC	contaminant of concern
CSM	Conceptual Site Model
D/U Reach	the Downtown Reach and the Upriver Reach
EDD	electronic data deliverable
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
FC	Field Coordinator
FS	feasibility study
FSP	Field Sampling Plan
Geosyntec	Geosyntec Consultants, Inc.
GPS	global positioning system
Gravity	Gravity Marine Services
GSI	GSI Water Solutions, Inc.
ID	identification
LWG	Lower Willamette Group
mm	millimeter
NAD	North American Datum of 1983
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PDI	pre-remedial design investigation
PHSS	Portland Harbor Superfund Site
Pre-RD AOC Group	Pre-Remedial Design Agreement and Order on Consent Investigation Group
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RI	remedial investigation
RM	river mile

ROD	Record of Decision
RV	research vessel
Site	Portland Harbor Superfund Site
SMA	sediment management area
SMB	smallmouth bass
SOP	Standard Operating Procedure
SOW	Statement of Work

1. INTRODUCTION

The Record of Decision (ROD) described a post-ROD sampling effort for the Portland Harbor Superfund Site (Site or PHSS; Figure 1) located in Portland, Oregon, to delineate and better refine the sediment management area (SMA) footprints, refine the Conceptual Site Model (CSM), determine baseline conditions, and support remedial design (U.S. Environmental Protection Agency [EPA] 2017a). Geosyntec Consultants, Inc. (Geosyntec) and AECOM Technical Services (AECOM) submitted a detailed Work Plan for Pre-Remedial Design Investigation and Baseline Sampling (PDI) on behalf of a group of industrial parties called the Pre-Remedial Design Agreement and Order on Consent Investigation Group (Pre-RD AOC Group). On December 19, 2017, EPA entered into an Administrative Settlement Agreement and Order on Consent (ASAOC) with the Pre-RD AOC Group to conduct the PDI studies at the Site (EPA 2017b). The ASAOC includes the Statement of Work (SOW) and the PDI Work Plan (an attachment to the SOW), which generally describe the field investigation activities, data analyses, schedule, and deliverables for the PDI.

These PDI studies are a foundational step in what will be a multi-phase effort to update current conditions from the collection of data during the remedial investigation (RI)/feasibility study (FS). The RI/FS was initiated by a group of potentially responsible parties known as the Lower Willamette Group (LWG) and completed by EPA in 2016 (EPA 2016a, 2016b). The RI consisted of three rounds of data collection, including surface and subsurface sediment, bank soils, surface water, sediment traps, porewater, and fish tissue, and other media from 2001 through 2007.

This Field Sampling Plan (FSP) was prepared to support the fish tissue sampling efforts outlined in the PDI Work Plan (Geosyntec 2017) and the project Quality Assurance Project Plan (QAPP) (AECOM and Geosyntec 2018). To the extent practicable, previously approved FSPs from the RI are referenced.

1.1 Project Setting

The PHSS is located in Portland, Oregon, on the lower Willamette River immediately downstream of the urban downtown. The Site extends from river mile (RM) 1.9 upstream to RM 11.8 and covers 2,190 acres (Figure 1). There are two reaches located immediately upstream of the Site. The Downtown Reach, which includes the urbanized area of downtown Portland, is defined by EPA as extending from RM 11.8 to RM 16.6. EPA defines the Upriver Reach as extending from RM 16.6 to RM 28.4. Collectively, the river from RM 11.8 to 28.4 is referred to as the D/U Reach.

1.2 Project Overview

The target species of the PDI 2018 Fish Tissue Study is smallmouth bass (SMB; *Micropterus dolomieu*) because of their abundance, more limited home range, extensive historical chemistry database, and importance in the baseline human health risk assessment (BHHRA). This study

builds on prior SMB sampling in the PHSS, including the 2002 and 2007 RI, the 2011 program (GSI Water Solutions, Inc. [GSI] 2011), and the 2012 program (Windward Environmental 2012)¹. The focus of this sampling effort is the collection of whole body SMB throughout the Site and upstream of the Site to characterize current concentrations of ROD Table 17 contaminants of concern (COCs). Fish tissue is one line of evidence for monitored natural recovery.

1.3 Fish Tissue Sampling Goals and Objectives

The PDI sampling provides a synoptic baseline chemistry dataset for sediment, fish tissue, and surface water for use in future long-term monitoring of the PHSS. As outlined in the QAPP, the goals of the PDI for fish tissue sampling include the following:

- Characterize current levels of fish tissue COCs in resident SMB tissue on a site-wide basis and smaller spatial scale.
- Characterize upriver concentrations in fish tissue.
- Update statistically based evaluations of polychlorinated biphenyl (PCB) differences and changes in fish tissue concentrations.
- Update and evaluate study area conditions to refine the CSM for all pathways consistent with the ROD.

2. SAMPLING DESIGN AND APPROACH

This section describes the sample design, sampling schedule, sample locations, sample size, and other sampling considerations. The overall design and methods are consistent with the *Sampling and Analysis Plan: Portland Harbor 2011 Baseline Smallmouth Bass Tissue Study* (GSI 2011) and *Portland Harbor RI/FS: 2012 Modifications to the Field Sampling Plan for Bass Tissue* (Windward Environmental 2012).

2.1 Fish Sampling Design

SMB have been collected from the Site several times, including 2002, 2007, 2011, and 2012, and analyzed for COCs in fillet and whole body tissue using individual and composite samples. The overall PDI sample design for SMB is consistent with the most recent and approved 2012 SMB program, which included sampling and analysis of whole body specimens throughout the Site and a portion of the D/U Reach. The design includes collection of one specimen from each of 95 sampling locations within the Site, as well as 20 specimens from the Downtown Reach and 20 from the Upriver Reach. The target number of specimens within the Site is the same as the 2012

¹ SMB tissue chemistry data collected as part of the 2011 and 2012 sampling programs were not included in the RI dataset.

program. While a total of 135 SMB are targeted, the number collected will be to the extent sufficient numbers of fish are present in the summer/fall of 2018.

2.2 Fish Sampling Schedule

Fish collection is expected to include two 10- to 12-day sessions: one session in August before Labor Day and one in September after Labor Day. This schedule includes a safety rest break over the Labor Day holiday weekend. The field schedule may be affected by adverse weather and fishing success. At the end of the first 10- to 12-day sampling session, the SMB catch rate will be evaluated in consultation with EPA to determine if adjustments to the FSP are needed to achieve the target sample number.

An optional boat electrofishing session (described below in Section 4.3.2) is proposed if numbers of specimens caught by hook-and-line angling at the proposed sampling locations are not sufficient.

2.3 Sampling Locations

A total of 135 sampling locations are proposed for the 2018 Study (Figure 2). Within the PHSS, the 95 sampling locations include areas that were successful in the 2011 and 2012 SMB studies and provide coverage of both sides of the river and the SMAs. Within the D/U Reach, 40 sampling locations are proposed to characterize upriver concentrations in resident fish tissue. Half of the sampling locations (n=20) are in the Downtown Reach and include locations previously sampled in the 2011 and 2012 programs. The remaining 20 sampling locations are located throughout the Upriver Reach up to Willamette Falls. Table 1 presents the proposed 2018 sample locations (final positioning will change based on the specific locations where fish are caught).

2.4 Specimen Lengths

Consistent with the 2011 and 2012 sampling, SMB that are 225 to 355 millimeters (mm) in total length (approximately 9 to 14 inches) will be targeted. Specimens that do not meet the target size range will be released. SMB larger than 355 mm may be retained for archival at the selected laboratory for possible future analysis.

2.5 Other Sampling Considerations

The specimens will be frozen and shipped to the laboratory for processing as whole fish samples. No compositing or filleting of SMB specimens will occur in the field. If any tagged fish from the Fish Tracking Study are caught, these specimens will be retained for chemical analysis (up to 10 tagged fish). Evaluation of the tissue chemistry and telemetry data will provide an understanding of the exposure history of the tagged fish.

2.6 Key Changes from Previously Approved FSPs

Fish sampling will be performed in accordance with EPA-approved project plans (GSI 2011, Windward Environmental 2012), except where noted. Key PDI changes include the following:

- Samples will be analyzed for the COCs listed in ROD Table 17 for fish tissue (presented in Table 6 of the PDI Work Plan).
- In addition to sample preparation and analysis by Axy's, an additional laboratory (ALS) will be used for analysis of specific ROD Table 17 COCs, as specified in Section 5 of this FSP and the project QAPP.
- Tissue sample identification codes will be modified to describe the 2018 PDI sampling, as described in Section 4.2.1 of the QAPP.

3. PROJECT ORGANIZATION AND FIELD TEAM

3.1 Team Organization and Responsibilities

EPA is the lead agency overseeing the work. The EPA Project Manager is Davis Zhen. EPA will be assisted in the review of technical documents by an oversight contractor.

Team organization is presented in detail in the PDI Work Plan and in Section 2 of the QAPP (AECOM and Geosyntec 2018a). As it relates to this FSP, AECOM is coordinating activities, including management of all subcontractors, field sampling, analysis, and reporting scoping tasks.

The PDI Project Coordinator, Mr. Ken Tyrrell, and PDI Project Manager, Dr. Jennifer Pretare, Ph.D. (AECOM), will be responsible for overall project coordination and providing oversight on planning and coordination, work plans, all project deliverables, and performance of the administrative tasks needed to ensure timely and successful completion of the project. Ms. Betsy Ruffle (AECOM) will serve as the senior technical lead for this study. Dr. Pretare is also the Project Field Coordinator (FC). In this role, she will oversee all phases of work, including planning, permitting, health and safety, logistics, field sample collection, sample packaging, and shipment to the laboratory. Dr. Pretare will be responsible for overall field study implementation and field data quality. Deviations from this FSP will not be made without prior approval from the FC. Dr. Pretare will oversee the preparation of the field report.

Mr. Andy Clodfelter and Mr. Glen Mejia (AECOM) are the Fish Tissue Study fisheries biologists. Mr. Clodfelter or Mr. Mejia may act as field supervisor at times when Dr. Pretare is not present at the study area. Both are qualified to implement fish tissue collection, maintain field documentation, and address any stipulations that may arise from scientific collection permits or Endangered Species Act (ESA) compliance for the study. The team is required to have

a qualified ESA fisheries biologist to identify and document any incidental catch of ESA-listed species.

The research vessels (RV) for this study will be provided by Gravity Marine Services (Gravity). Mr. Shawn Hinz is the point of contact for Gravity. One primary RV will be at least 30 feet in length and have capacity for up to 8 people, including observers, fishing gear, and coolers for sample storage. A second RV will be a smaller “jon boat” of less than 15 feet in length for navigating into nearshore areas. Gravity will provide RV captains and crew who are qualified to fish for SMB and to assist in tissue collection procedures. All team members will have valid State of Oregon fishing licenses.

The Oregon Bass & Panfish Club will assist as fishing guides and anglers. Volunteers from this organization have assisted the LWG in previous studies and have experience supporting scientific studies within Portland Harbor.

3.2 Communication/Information Flow

The communication strategy is outlined in Section 2 of the QAPP. The FC will be the point of contact for field staff during the implementation of this FSP. Deviations from this FSP or the project-specific QAPP will be reported to the PDI Project Manager for consultation. Significant deviations from the FSP/QAPP will be further reported to representatives of the Pre-RD AOC Group and EPA.

3.2.1 Coordination with EPA

The PDI Project Coordinator will notify the EPA Project Manager 1 to 2 weeks prior to beginning any field activities so that EPA can schedule any oversight activities required. The PDI Project Coordinator will also notify the EPA Project Manager once field activities have been completed.

4. SAMPLE COLLECTION PROCEDURES

This section describes the procedures and methods that will be used for sample collection; recordkeeping; sample handling, storage, and shipping protocols; and field quality assurance (QA)/quality control (QC) procedures. Sample collection will follow procedures outlined in the *2012 Modifications to the Field Sampling Plan for Bass Tissue* (Windward Environmental 2012) and the *Sampling and Analysis Plan: Portland Harbor 2011 Baseline Smallmouth Bass Tissue Study* (GSI 2011). The intended sample locations are described in Section 2.3 and displayed in Figures 2a and 2b and Figures 3a through 3i. Sampling will be conducted using a two-boat team. The smaller boat will have a boat operator and an angler. The remaining team members and any observers will be located on the larger RV. The precise team configuration may vary on a given day, but at a minimum one scientist and one angler not otherwise engaged in vessel operations will be present. The boat operator and deck hand will also serve as an angler when not operating

the vessels. All field work will be conducted in accordance with the project-specific Health and Safety Plan (AECOM and Geosyntec 2018b). Standard Operating Procedures (SOPs) associated with the fish tissue collection program are provided in Appendix A.

4.1 Sampling Vessel and Equipment

Sampling vessels will be provided and operated by Gravity. The proposed sampling vessels are R/V *Tieton* and a small 10-foot aluminum jon boat. The R/V *Tieton* is a 32-foot landing craft type vessel with a 16-foot working deck that provides a stable platform for fish sampling and angling. The small jon boat will be used to access sampling locations that require greater maneuverability.

4.2 Station Positioning and Navigation

Station position and navigation will be performed using methods outlined in the 2011 Sampling and Analysis Plan (GSI 2011). Latitude and longitude coordinates will be obtained using a global positioning system (GPS) on the vessels operated by Gravity. The standard projection method to be used during field activities is Horizontal Datum: North American Datum of 1983 (NAD83), State Plane Coordinate System, Oregon North Zone. The positioning objective is to accurately determine and record the position of the sampling vessel at each successful sampling location to within 1 to 2 meters.

4.3 Fish Collection

4.3.1 Angling

The fish collection SOP is provided in Appendix A. Angling will be conducted using a standard rod and reel with monofilament line (6-12 pound test). SMB can be caught with a variety of lures, depending on the desired sampling depth. For example, lead-weighted hooks with attached green-rubber tube jigs can be used to fish the bottom, while plastic crank baits resembling small fish or crayfish can be used to fish the shallower surface waters (zero to 4 meters). An electric trolling motor will be used on the Gravity-operated jon boat to more accurately access specific angling locations and enable the complete coverage of selected areas. Angling for SMB will be conducted primarily from 7:00 a.m. to 7:00 p.m. Once caught, fish will be handled using nitrile gloves, unhooked, and its length measured on a decontaminated measuring board. If a collected SMB is within the target size, it will be euthanized, weighed, and placed into individual labeled resealable plastic bags and placed in a cooler with ice as described in Section 4.3.4. AECOM scientists will be on board each boat to handle and document the fish and to record the GPS coordinates of the collection site.

4.3.2 Boat Electrofishing

If an insufficient number of SMB are caught by angling, boat electrofishing is proposed as an alternate collection method. Selection of boat electrofishing gear will be based on biological and environmental factors that influence gear efficiency. If boat electrofishing is required, an

addendum to this FSP will be developed. The decision to implement electrofishing will be made in concert with EPA, and electrofishing would likely occur in mid to late September after initial angling efforts have been completed.

4.3.3 Contingency Plan for Collecting Samples

During fish sampling efforts, the field crew may encounter field conditions that preclude collection of a SMB specimen at the planned location. For example, the combination of unsuitable river levels, currents, bathymetry, physical obstructions, and absence of catchable fish may preclude collecting a sample at the target location. If no target-sized SMB are captured within 30 minutes at a single location, the field crew will move to another sampling location. Effort will be taken to revisit target fish collection locations that were previously unproductive during the early morning or evening when SMB are more active feeders. Unproductive target locations will be visited at least twice if a sample is not collected from that location during the initial visit. Samples will be assigned the sample identification (ID) of the closest planned sample station.

4.3.4 Field Sample Handling

All field equipment used to collect and process fish will be decontaminated. All buckets, measuring boards, handheld scales, and coolers used to retrieve and store fish will be washed with AlconoxTM soap and rinsed in river water before sampling is initiated at each location.

Fish will be measured for total length by placing them on a measuring platform. The total length of a fish will be measured from the anterior-most part of the fish to the tip of the longest caudal fin ray (when the lobes of the caudal fin are compressed dorsoventrally). If the fish does not meet the target length range, the specimen will be returned to the river. Fish will be photographed as specified in the field documentation SOP.

Retained fish will be weighed using a handheld scale, euthanized, and placed inside a resealable plastic bag. Fish will be euthanized using a lethal dose of the anesthetic MS-222 (or other method recommended by the National Marine Fisheries Service and/or Oregon Department of Fish and Wildlife, or as stated in the Scientific Take Permit). A weatherproof label will be filled out and adhered to the inside of a smaller resealable plastic bag. The plastic bags containing the fish and the label then will be placed inside a third resealable plastic bag. All labels will be marked with the date, time, project name (or case number), specimen ID, and initials of the sampler, and the fish sample will be placed in a cooler with ice, as outlined in Section 4.3.4 of the QAPP and attached SOPs (Appendix A). Each retained fish and sample location will be photographed. GPS coordinates will be recorded in the field logbook.

At the end of each day, the coolers will be transported to the secure AECOM Sampling Processing Facility (1115 S.E. Caruthers Street), which will serve as a temporary processing and storage facility. The RVs may transfer fish coolers to field team members at the Swan Island Boat Ramp throughout the day depending on the success of the fish collection efforts. The fish

will be transferred to a chest freezer for frozen storage at the AECOM facility. Once frozen, the fish will be placed into coolers with dry ice before shipment to the contract laboratory.

Tagged fish that are submitted for fish tissue chemistry will be clearly identified when submitted to the laboratory using a note on the sample bag and chain-of-custody record indicating ‘tagged fish’. Before fish processing, the laboratory will remove the internal acoustic tag and external identification tag, record the tag IDs, and archive the tags in a sealed bag labeled with the fish sample ID.

4.4 Management of Investigation-Derived Waste

Fish collected but not retained for analysis will be immediately returned to the lower Willamette River from where they were collected. Water containing diluted amounts of phosphate-free detergent (i.e., Alconox) used for decontaminating the sample processing equipment will also be released to the lower Willamette River at the same sample location. Other consumables such as disposable sampling equipment, fish surgical tools, and gloves will be bagged for disposal and managed as a solid waste and discarded as general municipal waste.

5. LABORATORY ANALYSIS

The chemical analysis of tissue samples will be performed by the following laboratories, or as specified in the QAPP (AECOM and Geosyntec 2018):

- SGS Axys Analytical Services in British Columbia, Canada, will homogenize each whole body specimen as a discrete sample and analyze the samples for: chlorinated pesticides and hexachlorobenzene, PCB congeners, dioxins/furans (2,3,7,8-TCDD eq), polybrominated diphenyl ethers (PBDEs), and lipids.
- ALS Environmental in Kelso, Washington, will analyze homogenized tissue samples for arsenic, mercury, bis-2-ethylhexylphthalate (BEHP), and pentachlorophenol.

Laboratory QC and data validation protocols will be followed to ensure that data quality and representation are in accordance with method requirements. Additional information is provided in the QAPP. Laboratory QA/QC will be maintained through the use of standard EPA methods and other accepted methods and standard analytical procedures for the target analytes. Laboratory methods, QA procedures, and QA/QC requirements for the sampling are generally equivalent to the LWG protocols for tissue chemistry described in *Round 3B Field Sampling Plan for Fish and Invertebrate Tissue and Collocated Surface Sediment* (Integral Consulting 2007).

6. DATA MANAGEMENT AND REPORTING

All data management will be performed according to the QAPP and Data Quality Monitoring Plan.

6.1 Field Documentation and Reporting

A bound field logbook will be assigned to and maintained by AECOM field team members to provide daily records of significant events, observations, and measurements during the field effort. Each page will be numbered, signed, and dated. These logbooks will be kept as permanent records. Complete field record-keeping details can be found in the project QAPP.

A brief activity log will be filed with the FC at the completion of each working day. This log will summarize the work activities undertaken/completed each day, progress, personnel on-site, hours worked, health and safety concerns, and any technical issues encountered. Field logbooks and field data sheets completed during fish collection activities will be scanned and emailed to the FC at the conclusion of each working day (or as soon as practically possible).

6.2 Plan Deviations

Deviations to this FSP potentially include the sampling of alternate stations or scope reductions/enhancements related to site conditions or real-time information. Safety will be given the highest priority in all aspects, and the Project FC/PDI Project Manager will be responsible for documenting all plan deviations.

6.3 Data Management and Retention

All related documentation is to be maintained in the project file either in electronic or hardcopy form. All hardcopy records will be maintained in the project file; all electronic records will be maintained in project-specific directories within AECOM's network and a final electronic data deliverable (EDD) will be provided to EPA at the conclusion of the PDI study.

7. REFERENCES

AECOM (AECOM Technical Services) and Geosyntec (Geosyntec Consultants, Inc.). 2018a. Quality Assurance Project Plan. Draft. Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling, Portland Harbor Superfund Site, Portland, Oregon. January.

AECOM and Geosyntec. 2018b. Programmatic HAZWOPER Health and Safety Plan. Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. Portland Harbor Superfund Site. January 2018.

- EPA (United States Environmental Protection Agency). 2016a. Portland Harbor RI/FS, Final Remedial Investigation Report, Portland, Oregon. United States Environmental Protection Agency Region 10, Seattle, Washington. 8 February.
- EPA (United States Environmental Protection Agency). 2016b. Portland Harbor RI/FS, Final Feasibility Study. Portland, Oregon. United States Environmental Protection Agency Region 10, Seattle, Washington. June.
- EPA. 2017a. Record of Decision Portland Harbor Superfund Site, Portland, Oregon. United States Environmental Protection Agency Region 10, Seattle, WA. January.
- EPA. 2017b. Administrative Settlement Agreement and Order on Consent and Statement of Work for Pre-Remedial Design Investigation and Baseline Sampling. Agreement between EPA Region 10, Seattle Washington and the Pre-Remedial Design Group. CERCLA Docket No. 10-2018-0236. December 19.
- Geosyntec (Geosyntec Consultants, Inc.). 2017. Final Work Plan. Portland Harbor Pre-Remedial Design Investigation Studies, Portland Harbor Superfund Site, Portland, Oregon. Prepared for the Pre-RD AOC Group for submittal to EPA Region 10 (attached to the final Statement of Work). December 19.
- GSI (GSI Water Solutions, Inc.). 2011. Portland Harbor 2011 Baseline Smallmouth Bass Tissue Study, Sampling and Analysis Plan, Willamette River, Portland, Oregon. Prepared for U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, and City of Portland.
- Integral Consulting. 2007. Portland Harbor RI/FS Round 3B Field Sampling Plan for Fish and Invertebrate Tissue and Co-located Surface Sediment, Appendix C: Standard Operating Procedures for Fish Tissue Processing and Shipping. Integral Consulting Inc. Mercer Island, WA.
- Windward Environmental. 2012. Portland Harbor RI/FS: 2012 Modifications to the Field Sampling Plan for Bass Tissue. Prepared for the Lower Willamette Group, Portland, OR. Windward Environmental LLC, Seattle, WA.

TABLES

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Table 1. Sample Identification and Coordinates

Sample Identification Number	X Coordinate	Y Coordinate
1	7617437.71419000000	724272.07372800000
2	7617263.71327000000	723910.07493700000
3	7617134.71241000000	723598.07595000000
4	7617024.71110000000	723191.07718000000
5	7616907.70922000000	722636.07880800000
6	7616830.70749000000	722149.08019800000
7	7616816.70571000000	721700.08138100000
8	7615061.70924000000	721237.08570400000
9	7616822.70324000000	721094.08293500000
10	7615093.70673000000	720644.08723200000
11	7615153.70442000000	720121.08851800000
12	7615191.70220000000	719604.08982500000
13	7615224.69982000000	719042.09125800000
14	7618403.68261000000	717182.08984900000
15	7618976.68084000000	717174.08872700000
16	7617968.68276000000	716893.09144000000
17	7618159.67987000000	716318.09249100000
18	7616685.68128000000	715566.09743500000
19	7616879.67893000000	715130.09814600000
20	7618423.67672000000	715734.09339900000
21	7617145.67657000000	714745.09856500000
22	7617334.67445000000	714359.09914000000
23	7617495.67249000000	713994.09971500000
24	7619391.27991000000	714508.53213900000
25	7619824.79457000000	713282.68334500000
26	7618265.66354000000	712344.10213600000
27	7618709.65920000000	711594.10297400000
28	7619090.65568000000	711000.10354300000
29	7619452.65234000000	710436.10405900000
30	7619834.64893000000	709867.10451800000
31	7621605.64097000000	709180.10187500000
32	7621091.63904000000	708320.10510500000
33	7622526.63471000000	708289.10164500000
34	7621964.63238000000	707290.10528800000
35	7623394.62878000000	707436.10137700000
36	7622760.62702000000	706526.10498200000
37	7623615.62204000000	705897.10416400000
38	7624258.62392000000	706845.10047900000
39	7624442.61790000000	705458.10296000000
40	7625192.61853000000	706169.09952600000
41	7625134.61418000000	705025.10206100000
42	7626030.60944000000	704480.10081700000
43	7626773.61084000000	705582.09470700000
44	7627152.60960000000	705654.09251600000
45	7626699.60315000000	703567.09907100000
46	7627580.60258000000	704319.09284700000
47	7627609.59634000000	702777.09574800000
48	7628673.59514000000	703557.08848400000
49	7629560.58995000000	703150.08453600000

Table 1. Sample Identification and Coordinates

50	7628446.58993000000	702011.09279100000
51	7629919.58606000000	702534.08385300000
52	7628532.58580000000	701058.09423600000
53	7630455.58216000000	702097.08186700000
54	7628808.58236000000	700472.09393900000
55	7631196.57751000000	701677.07875800000
56	7631959.57382000000	701523.07499400000
57	7630201.57420000000	699831.08781900000
58	7632539.57220000000	701705.07151800000
59	7630870.56849000000	699074.08580500000
60	7633192.56803000000	701318.06882800000
61	7632882.56699000000	700741.07167800000
62	7631605.56090000000	697908.08429700000
63	7634185.56202000000	700811.06458100000
64	7632424.55480000000	697204.08142000000
65	7632957.55165000000	696951.07913200000
66	7633409.54921000000	696796.07707100000
67	7634401.55078000000	698198.06890100000
68	7635462.55258000000	699730.06004700000
69	7633863.54668000000	696619.07504700000
70	7634827.54760000000	697830.06741900000
71	7634364.54331000000	696280.07311800000
72	7635448.54339000000	697402.06503900000
73	7636408.54508000000	698803.05698500000
74	7636177.53859000000	696933.06218300000
75	7636817.53465000000	696589.05954100000
76	7637472.53021000000	696135.05706200000
77	7637191.52317000000	694077.06295200000
78	7637653.52255000000	694390.05986100000
79	7638614.52332000000	695559.05229500000
80	7638374.51807000000	693994.05694100000
81	7639902.51383000000	694478.04788600000
82	7639060.51290000000	693389.05466600000
83	7640408.50757000000	693415.04756700000
84	7639756.50746000000	692725.05248200000
85	7641240.50007000000	692370.04552800000
86	7640899.49483000000	690703.05098100000
87	7641982.48779000000	690029.04686600000
88	7643359.48177000000	689911.04000700000
89	7643030.47913000000	688912.04394700000
90	7644012.47687000000	689339.03791900000
91	7644650.47214000000	688795.03585800000
92	7644119.47063000000	687877.04066900000
93	7645078.46765000000	688101.03522900000
94	7645566.46256000000	687313.03451700000
95	7645132.46231000000	686811.03788800000
96	7645445.38150000000	686564.74575300000
97	7645822.04588000000	686849.64069800000
98	7646853.56976000000	685599.25519800000
99	7646331.32085000000	684049.39441400000
100	7646579.36235000000	682830.80423000000
101	7646291.74276000000	681175.82960300000
102	7645250.42259000000	679628.37469600000
103	7646565.14713000000	676323.02647700000

Table 1. Sample Identification and Coordinates

104	7647960.65215000000	675471.28803700000
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106	7648189.18301000000	673056.61211700000
107	7646255.15851000000	672363.18477600000
108	7649903.00867000000	670977.88675500000
109	7645328.97063000000	671121.74432500000
110	7646369.40451000000	669386.50678500000
111	7647151.38293000000	668746.08132300000
112	7648972.62629000000	668328.17531400000
113	7647120.37841000000	667557.08624400000
114	7646048.29649000000	666503.01601600000
115	7645738.37386000000	665044.10270000000
116	7646059.36345000000	662694.11058700000
117	7647690.20938000000	661083.12666400000
118	7648242.29847000000	659449.63741600000
119	7648368.33580000000	657765.12025600000
120	7649424.32423000000	655746.12399900000
121	7651899.55409000000	655207.58440400000
122	7650961.58149000000	653033.45089000000
123	7650258.82452000000	650650.38182600000
124	7649306.60712000000	649544.81331700000
125	7648122.97324000000	645258.29682800000
126	7648711.15655000000	642577.70524500000
127	7650472.27957000000	641304.37452000000
128	7651101.53546000000	640038.59816400000
129	7654016.77343000000	637440.02721200000
130	7655627.81432000000	635179.39463100000
131	7657722.94472000000	631679.40957400000
132	7658373.97840000000	629403.47125200000
133	7660736.74126000000	628686.45873800000
134	7661588.89468000000	625612.07037800000
135	7658407.36831000000	622302.42977400000

Notes:

1. Samples numbered sequentially based on location downstream to upstream from RM 1 to 135 (matches methodology used for other sampling locations).
2. Horizontal Projection: NAD 1983 Oregon State Plane North (Intl Feet)

Acronyms:

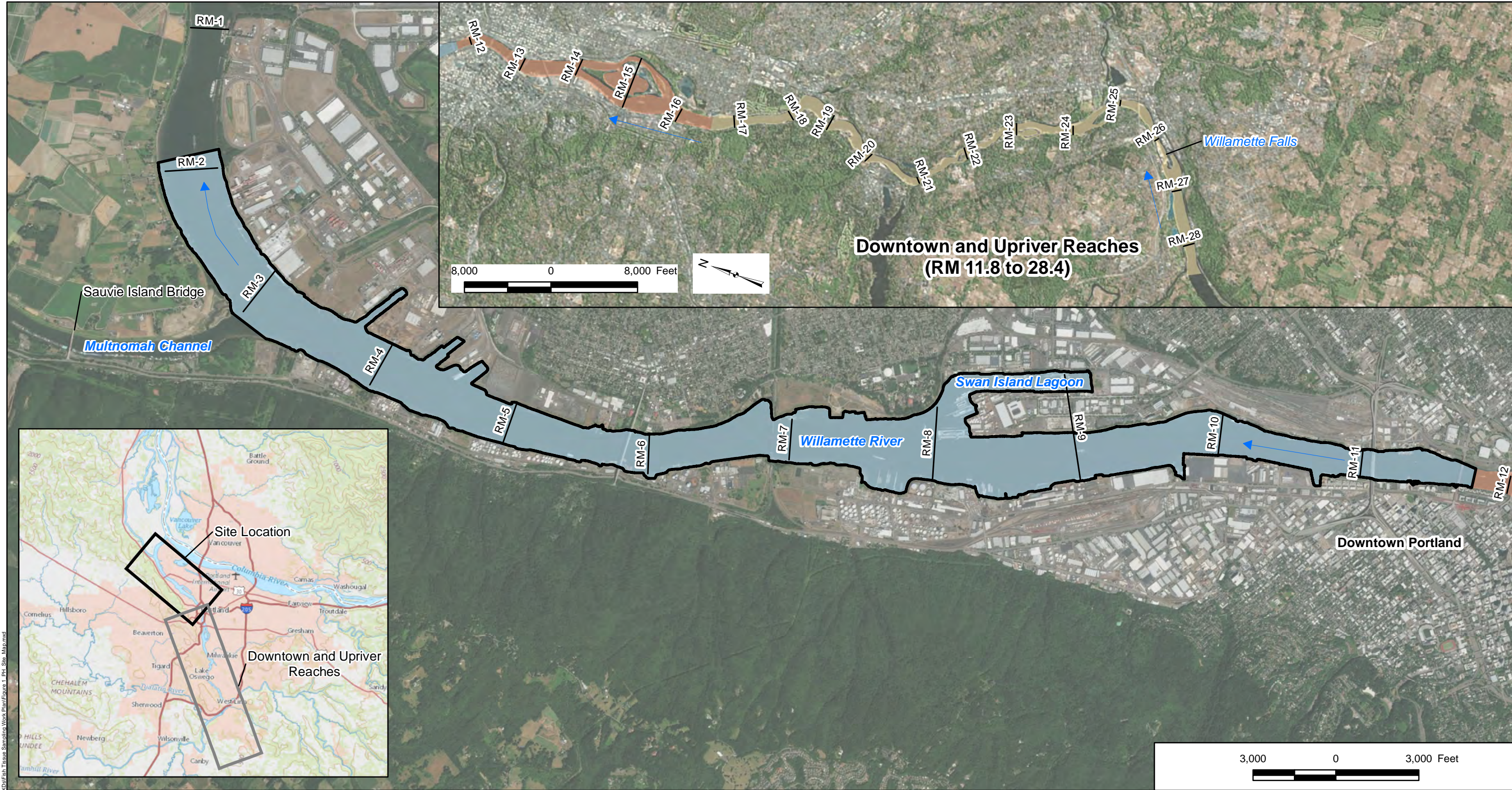
RM = river mile

NAD = North American Datum

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FIGURES

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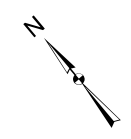


Legend

- Flow Direction
- River Mile Marker
- Superfund Site Boundary (RM 1.9 to 11.8)

Study Area

- Site Area (RM 1.9 to 11.8)
- Downtown Reach (RM 11.8 to 16.6)
- Upriver Reach (RM 16.6 to 28.4)



Note:
1. Aerial Imagery provided by ESRI Basemaps 2016

3,000 0 3,000 Feet

Portland Harbor Site Map
Portland Harbor Superfund Site
PDI Fish Tissue FSP



Figure
1

MI/SEA

January 18, 2018

Path: P:\Projects\Portland Pre-Design\FIG072\A100 GIS and CAD\MapDocs\Fish Tissue Sampling Work Plan\Figure 1 PH Site Map.mxd

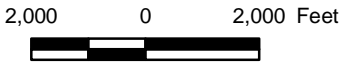


Path: P:\Projects\Portland Pre-Design\RM\GZ\A\00 GIS and CAD\MapDocs\Fish Tissue Sampling Work Plan\Figure 2a PH Fish Tissue All.mxd

Legend

- ★ Proposed Fish Tissue Sample Location (n = 135)
- Superfund Site Boundary (RM 1.9 to 11.8)
- Alternative F Mod SMA Footprint

Note:
1. Aerial Imagery provided by ESRI Basemaps 2017
2. n - sample count, RM - River Mile, SMA - Sediment Management Area
3. Site defined as RM 1.9 to 11.8
4. The Downtown Reach is defined by EPA as extending from RM 11.8 to RM 16.6 and Upriver Reach is defined by EPA as extending from RM 16.6 to RM 28.4
5. Fish tissue sample collection locations shown in this figure are proposed and do not reflect final positioning based on field conditions



Summary of Proposed Fish Tissue Sampling Locations (RM 1.9 to 20)

Portland Harbor Superfund Site
PDI Fish Tissue FSP



MI/SEA January 18, 2018

Figure 2a



Legend

- ★ Proposed Fish Tissue Sample Location (n = 135)
- Alternative F Mod SMA Footprint

Note:

1. Aerial Imagery provided by ESRI Basemaps 2017
2. n - sample count, RM - River Mile, SMA - Sediment Management Area
3. Site defined as RM 1.9 to 11.8
4. The Downtown Reach is defined by EPA as extending from RM 11.8 to RM 16.6 and Upriver Reach is defined by EPA as extending from RM 16.6 to RM 28.4
5. Fish tissue sample collection locations shown in this figure are proposed and do not reflect final positioning based on field conditions

2,000 0 2,000 Feet

Summary of Proposed Fish Tissue Sampling Locations (RM 20 to 28.4)

Portland Harbor Superfund Site
PDI Fish Tissue FSP

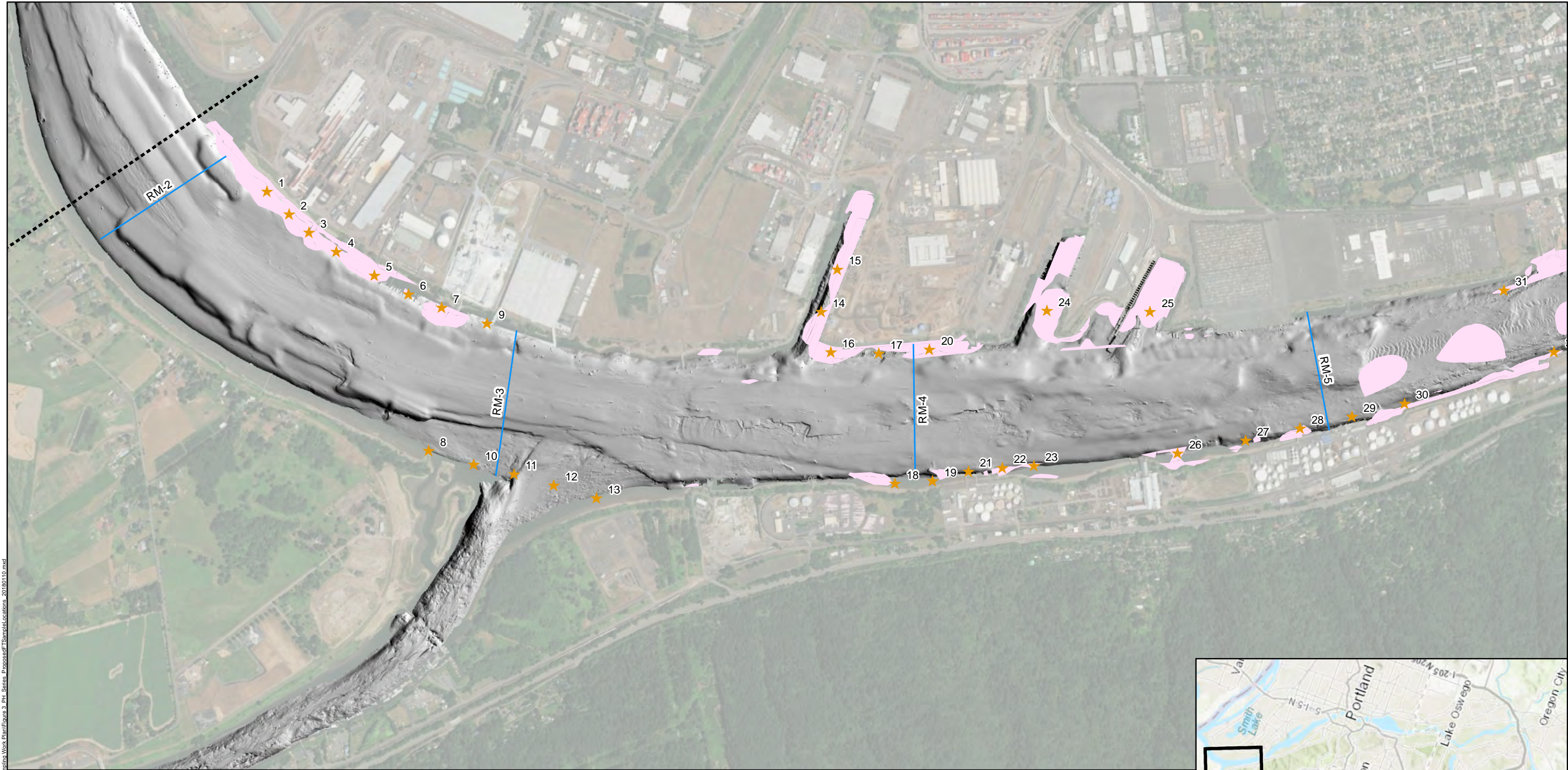
AECOM

MI/SEA

Geosyntec
consultants

January 18, 2018

Figure 2b

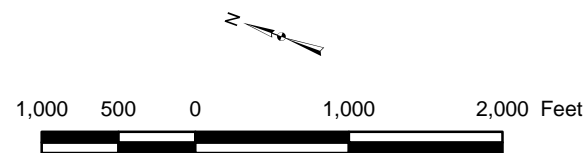


Path: P:\Projects\Portland_PDI\Design\RM\GZ\A\300 GIS and CAD\MapDocs\Fish Tissue Sampling Work Plan\Figure 3 - PDI_Series_Proposed_Fish_Tissue_Sampling_Locations_20180110.mxd

Legend

- ★ Proposed Fish Tissue Sample Location (n = 135)
- Superfund Site Boundary (RM 1.9 to 11.8)
- River Mile Marker
- Capped Area (Existing)
- Alternative F Mod SMA Footprint

Notes:
1. Aerial Imagery provided by ESRI Basemaps 2017.
2. Hillshade derived from 2009 NOAA bathymetric survey.
3. n - sample count, RM - river mile, SMA - Sediment Management Area.



Proposed Fish Tissue Sampling Locations RM 1.9 to 5

Portland Harbor Superfund Site
PDI Fish Tissue FSP

AECOM Geosyntec
consultants

MI/SEA

January 18, 2018

Figure

3a

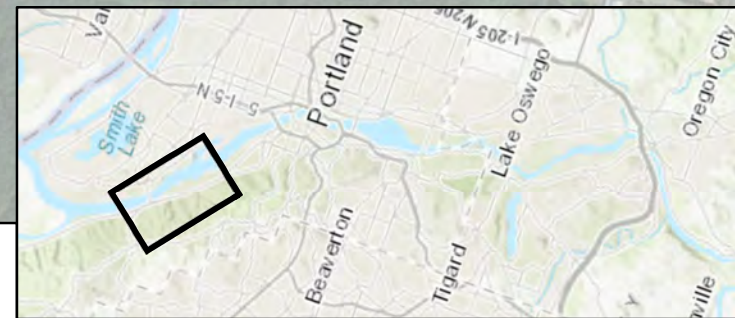
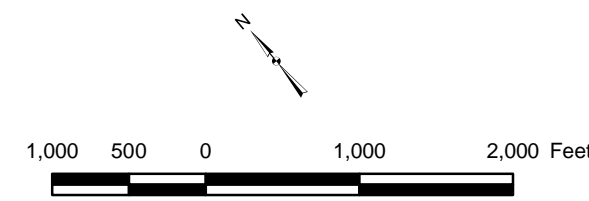


Path: P:\Projects\Portland_PDI\Design\FIG07\Fish Tissue Sampling Work Plan\Figure 3_PDI_Series_Proposed_Fish Tissue Sampling Locations_20180110.mxd

Legend

- ★ Proposed Fish Tissue Sample Location (n = 135)
- Superfund Site Boundary (RM 1.9 to 11.8)
- River Mile Marker
- Capped Area (Existing)
- Alternative F Mod SMA Footprint

Notes:
1. Aerial Imagery provided by ESRI Basemaps 2017.
2. Hillshade derived from 2009 NOAA bathymetric survey.
3. n - sample count, RM - river mile, SMA - Sediment Management Area.



Proposed Fish Tissue Sampling Locations RM 5 to 8 Portland Harbor Superfund Site PDI Fish Tissue FSP	
AECOM	Geosyntec consultants
MI/SEA	January 18, 2018

**Figure
3b**

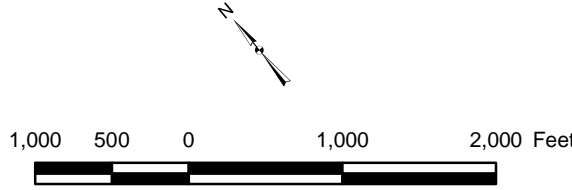


Path: P:\Projects\Portland_PDI\Design\FIG02\Fish Tissue Sampling Work Plan\Figure 3_PDI_Series_ProposedFishTissueLocations_20180110.mxd

Legend

- ★ Proposed Fish Tissue Sample Location (n = 135)
- Superfund Site Boundary (RM 1.9 to 11.8)
- River Mile Marker
- Capped Area (Existing)
- Alternative F Mod SMA Footprint

Notes:
1. Aerial Imagery provided by ESRI Basemaps 2017.
2. Hillshade derived from 2009 NOAA bathymetric survey.
3. n - sample count, RM - river mile, SMA - Sediment Management Area.



Proposed Fish Tissue Sampling Locations RM 8 to 11 Portland Harbor Superfund Site PDI Fish Tissue FSP	
AECOM	Geosyntec consultants
MI/SEA	January 18, 2018
Figure 3c	

Path: P:\Projects\Portland_PDI\Design\FIG02\Fish Tissue Sampling Work Plan\Figure 3_PDI_Series_ProposedFishTissueLocations_20180110.mxd



Legend

Proposed Fish Tissue Sample Location (n = 135)

Superfund Site Boundary (RM 1.9 to 11.8)

River Mile Marker

Capped Area (Existing)

Alternative F Mod SMA Footprint

Notes:

1. Aerial Imagery provided by ESRI Basemaps 2017.

2. Hillshade derived from 2009 NOAA bathymetric survey.

3. n - sample count, RM - river mile, SMA - Sediment Management Area.

1,000 500 0 1,000 2,000 Feet

**Proposed Fish Tissue Sampling Locations
RM 11 to 14**

Portland Harbor Superfund Site
PDI Fish Tissue FSP

AECOM

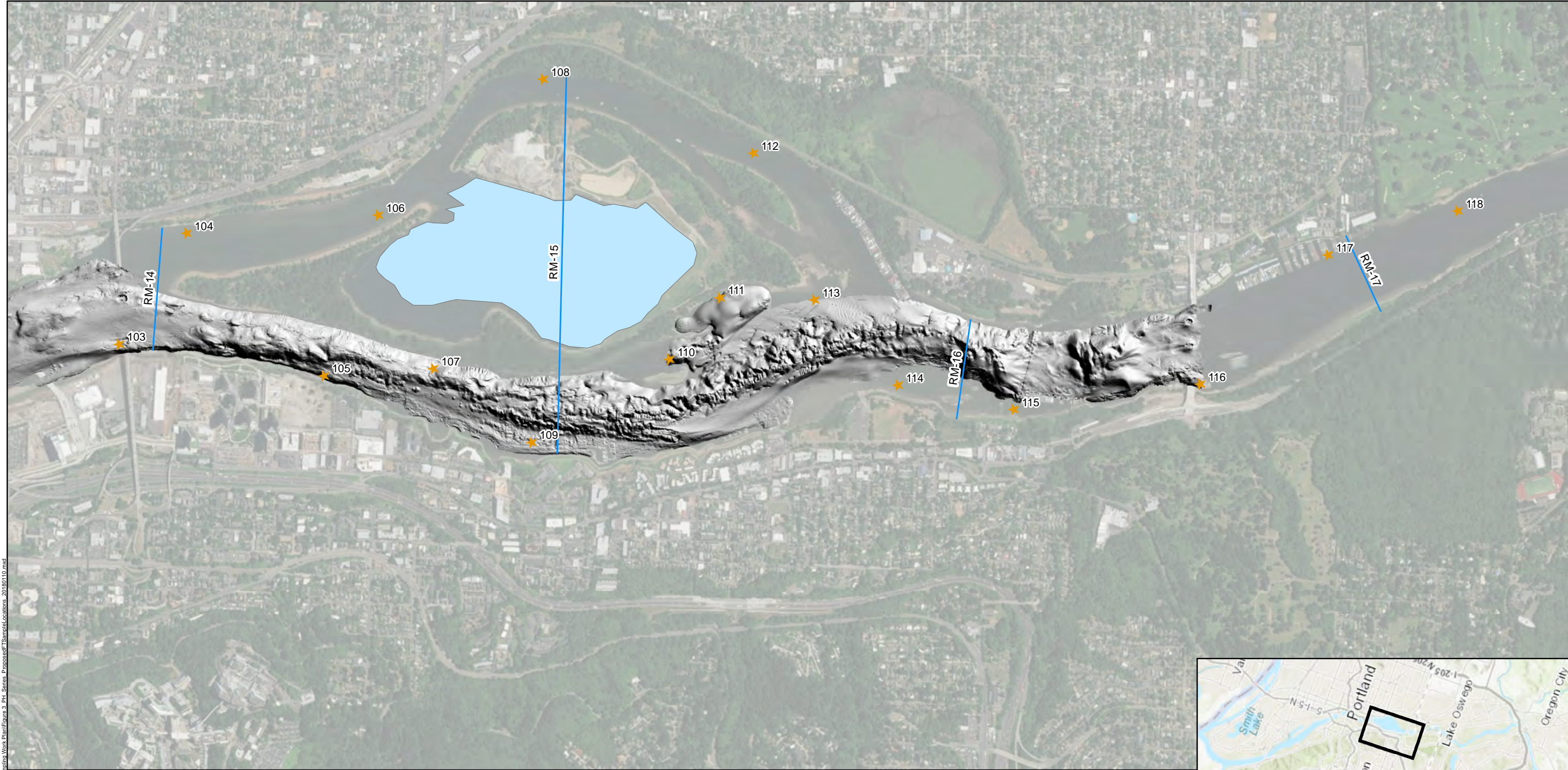
Geosyntec
consultants

MI/SEA

January 18, 2018

Figure

3d

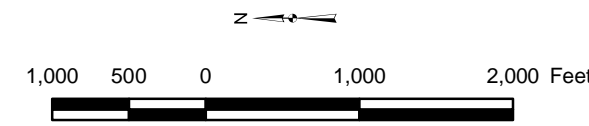


Path: P:\Projects\Portland Harbor\Pre-Design\RMG\Z\Fish Tissue Sampling Work Plan\Figure 3 - Fish Tissue Sampling Locations 20180110.mxd

Legend

- ★ Proposed Fish Tissue Sample Location (n = 135)
- Superfund Site Boundary (RM 1.9 to 11.8)
- River Mile Marker
- Capped Area (Existing)
- Alternative F Mod SMA Footprint

Notes:
1. Aerial Imagery provided by ESRI Basemaps 2017.
2. Hillshade derived from 2009 NOAA bathymetric survey.
3. n - sample count, RM - river mile, SMA - Sediment Management Area.



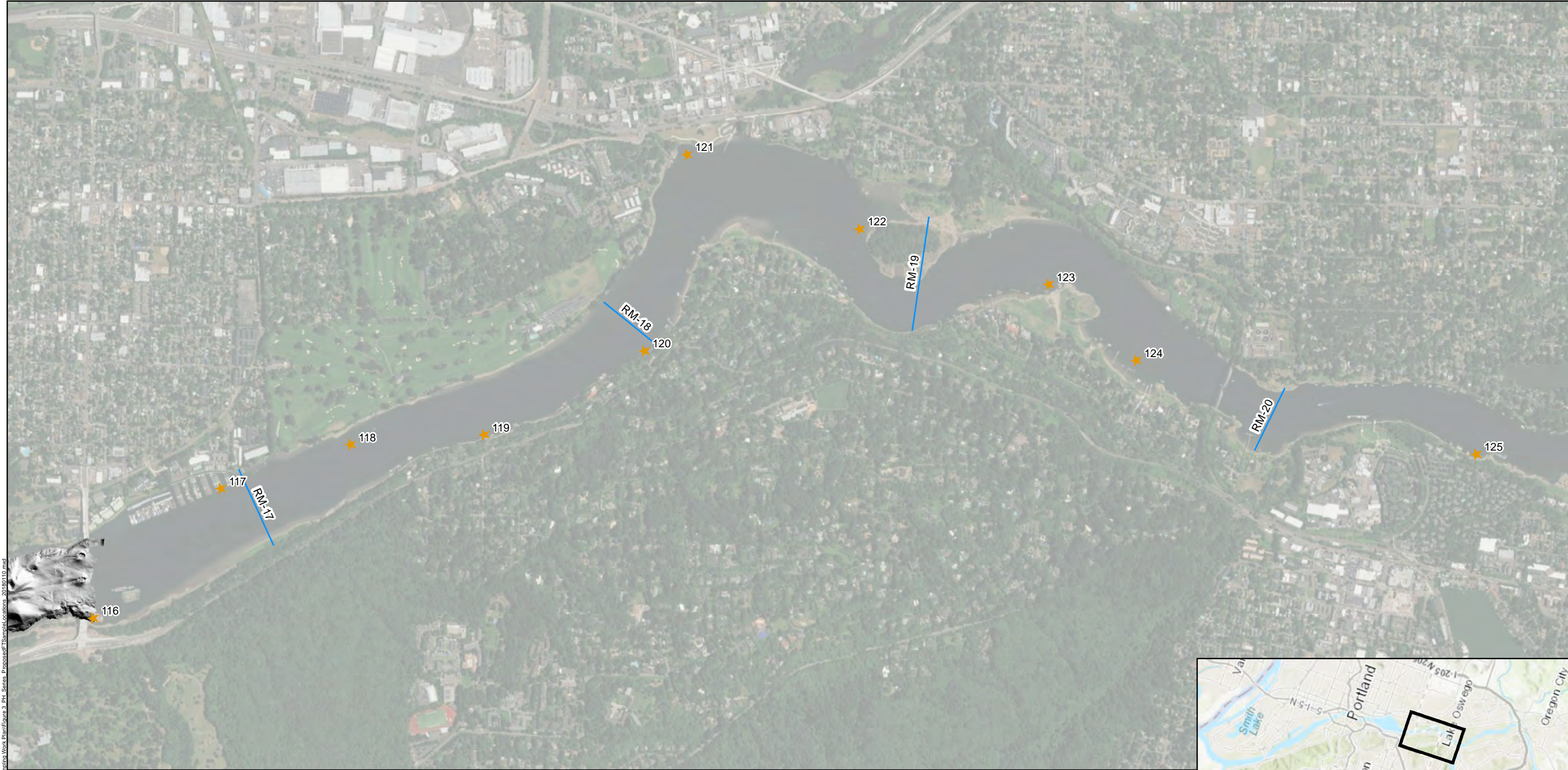
**Proposed Fish Tissue Sampling Locations
RM 14 to 17**

Portland Harbor Superfund Site
PDI Fish Tissue FSP



MI/SEA January 18, 2018

Figure
3e

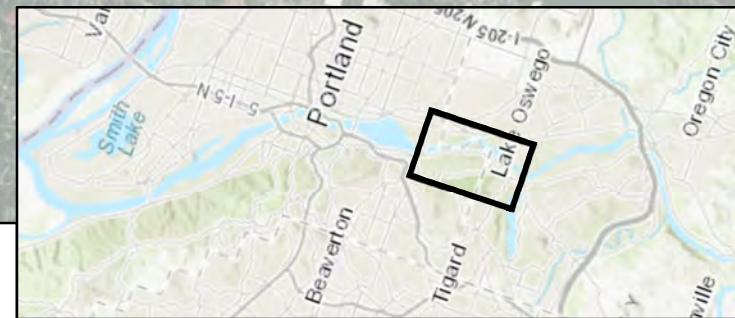
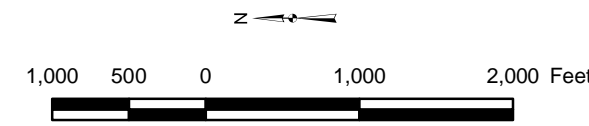


Path: P:\Projects\Portland Harbor\Pre-Design\FIG02\Fish Tissue Sampling Work Plan\Figure 3. PDI Series - Proposed Fish Tissue Sampling Locations - 20180110.mxd

Legend

- ★ Proposed Fish Tissue Sample Location (n = 135)
- Superfund Site Boundary (RM 1.9 to 11.8)
- River Mile Marker
- Capped Area (Existing)
- Alternative F Mod SMA Footprint

Notes:
1. Aerial Imagery provided by ESRI Basemaps 2017.
2. Hillshade derived from 2009 NOAA bathymetric survey.
3. n - sample count, RM - river mile, SMA - Sediment Management Area.



Proposed Fish Tissue Sampling Locations RM 17 to 20

Portland Harbor Superfund Site
PDI Fish Tissue FSP



MI/SEA

January 18, 2018

Figure

3f

Path: P:\Projects\Portland Pre-Design\FIG072\A100 GIS and CAD\MapDocs\Fish Tissue Sampling Work Plan\Figure 3 - PDI Series - Proposed Fish Tissue Sampling Locations - 20180110.mxd



Legend

- ★ Proposed Fish Tissue Sample Location (n = 135)
- Superfund Site Boundary (RM 1.9 to 11.8)
- River Mile Marker
- Capped Area (Existing)
- Alternative F Mod SMA Footprint

Notes:

1. Aerial Imagery provided by ESRI Basemaps 2017.
2. Hillshade derived from 2009 NOAA bathymetric survey.
3. n - sample count, RM - river mile, SMA - Sediment Management Area.



**Proposed Fish Tissue Sampling Locations
RM 20 to 23**

Portland Harbor Superfund Site
PDI Fish Tissue FSP

MI/SEA

January 18, 2018

Figure
3g

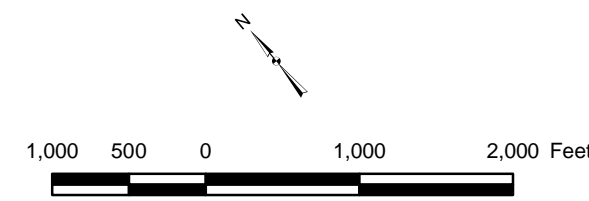


Path: P:\Projects\Portland_PDI\Design\FIG02\Fish Tissue Sampling Work Plan\Figure 3_PDI_Series_ProposedFishTissueLocations_20180110.mxd

Legend

- ★ Proposed Fish Tissue Sample Location (n = 135)
- Superfund Site Boundary (RM 1.9 to 11.8)
- River Mile Marker
- Capped Area (Existing)
- Alternative F Mod SMA Footprint

Notes:
1. Aerial Imagery provided by ESRI Basemaps 2017.
2. Hillshade derived from 2009 NOAA bathymetric survey.
3. n - sample count, RM - river mile, SMA - Sediment Management Area.



Proposed Fish Tissue Sampling Locations RM 23 to 26

Portland Harbor Superfund Site
PDI Fish Tissue FSP



MI/SEA January 18, 2018

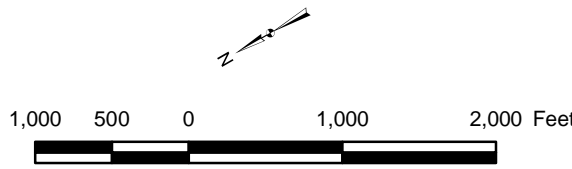
Figure
3h



Path: P:\Projects\Portland_PDI\Design\FIG02\Fish Tissue Sampling Work Plan\Figure 3_PFI_Series_Proposed Fish Tissue Sampling Locations_20180110.mxd

- Legend**
- ★ Proposed Fish Tissue Sample Location (n = 135)
 - Superfund Site Boundary (RM 1.9 to 11.8)
 - River Mile Marker
 - Capped Area (Existing)
 - Alternative F Mod SMA Footprint

Notes:
1. Aerial Imagery provided by ESRI Basemaps 2017.
2. Hillshade derived from 2009 NOAA bathymetric survey.
3. n - sample count, RM - river mile, SMA - Sediment Management Area.



Proposed Fish Tissue Sampling Locations RM 26 to 28.4 Portland Harbor Superfund Site PDI Fish Tissue FSP	
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MI/SEA	January 18, 2018
Figure 3i	

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